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Maturity Characteristics and Seasonal Variations in the Quality of Texas Citrus

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Maturity Characteristics and Seasonal Variations in the Quality of Texas Citrus

By Robert R. Cruse and Harold E. Brown[1]

ABSTRACT

A 5-year study (1969–73) was conducted in five groves in the major citrus-producing areas of the Rio Grande Valley to obtain data on two early-season orange varieties, 'Marrs' and 'Hamlin'; a late-season orange variety, 'Valencia'; and 'Ruby Red' grapefruit. The ranges in maturity values for 'Marrs' were: degrees Brix, 9.6–16.5; acid content, 0.21%–1.39%; juice yield, 48%–68%; pulp content, 11%–30%; and L-ascorbic acid (vitamin C) content, 24–52 mg/100 ml of juice. The ranges for 'Hamlin' were: degrees Brix, 9.2–16.5; acid content, 0.45%–1.60%; juice yield, 41%–68%; and vitamin C content, 22–62 mg/100 ml of juice. The ranges for 'Valencia' were: degrees Brix, 10.8–15.2; acid content, 0.24%–1.54%; juice yield, 41%–72%; and vitamin C content, 24–52 mg/100 ml of juice. Pulp yields for 'Hamlin' were similar to those for 'Marrs' but were less for 'Valencia' than for the early-season oranges. Color during the season was lightest in 'Hamlin' and darkest in 'Valencia'. The ranges in maturity values for 'Ruby Red' grapefruit were: degrees Brix, 9.4–13.1; acid content, 0.82%–1.98%; juice yield, 41%–72%; pulp content, 10%–20%; and vitamin C content, 16–50 mg/100 ml of juice. Color of the grapefruit flesh faded significantly with advancing maturity, as evidenced in the juice. Location of the groves had no significant effect on maturity. Index terms: citrus, fruit quality, grapefruit, 'Hamlin', 'Marrs', maturity characteristics, oranges, Rio Grande Valley, 'Ruby Red', 'Valencia'.

INTRODUCTION

Current maturity data on Texas citrus have not been available since a change was made in the USDA citrus standards in 1964. This study (1969–73) was initiated to obtain not only updated maturity data but also to investigate seasonal variations in fruit quality. Some of the data contained herein have been published in condensed form to demonstrate the blending possibilities of orange juice that is to remain within Grade A standards (Cruse and Lime 1974a), the application of the Hunter citrus colorimeter to Texas orange juice (Cruse and Lime 1974b), and the content and seasonal variation of vitamin C (L-ascorbic acid) in both oranges and grapefruit (Cruse and Lime 1977a, 1977b). More recently, interest has been expressed by several groups, especially the citrus industry in Texas and Florida, in having a more detailed presentation of these maturity data on Texas citrus. This publication is a result of that interest.

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MATERIALS AND METHODS

Five groves, located in the major citrus producing areas of the Lower Rio Grande Valley of Texas, were chosen for this study. Grove 1 is located in the eastern area, in Cameron County, near La Feria and grove 2 is located in the northern area, in Hidalgo and Willacy Counties, near Monte Alto. Groves 3, 4, and 5 are in the Mission-McAllen-Edinburg triangle in the western portion of Hidalgo County. The grove locations were selected to include representative samplings of the production areas. These groves are in an overall area extending some 15 miles east, 20 miles west, 1 mile south, and 20 miles north of Weslaco.

All groves have the three major orange varieties, 'Marrs' and 'Hamlin' (early season) and 'Valencia' (late season), and 'Ruby Red' grapefruit. Eight trees of each variety were selected in each grove, located where possible in a block of two rows of four trees each. However, this arrangement was not always feasible because of widely variable sets of fruit. Trees having good sets of fruit were chosen in as close proximity to each other as possible. All groves were under professional grove care and therefore received adequate cultural practices for maximum production.

The fruit were gathered biweekly; seven fruit were picked completely at random from the circumference of each tree. Care was taken that all quadrants of the trees were represented. Picking heights ranged from ground level (2–3 inches) to about 6.5 feet. Thus, each sample usually contained 56 separate fruit per sampling date per variety. An additional 15–20 fruit of both oranges and grapefruit were picked separately for priming the extractor. Towards the end of the season, some samples were smaller, but none consisted of less than 40 fruit.

The fruit were washed on a set of brush rolls and rain-dried. Samples were weighed, and the juice was extracted with a Food Machinery and Chemical Co. (FMC) model 091 B in-line extractor (used by the State of Florida for testing) fitted with 0.025-inch (0.63-mm) screens and having a beam setting of one-eighth of an inch (3.2 mm). Plates over the pump exit were pressurized with air at 18 lb/in^{2}g (1.27 kg/cm^2). The juice was weighed and deaerated at 30 inches (762 mm) of vacuum.

Degrees Brix was determined with a spindle hydrometer (range of 5–15 degrees Brix) having a built-in thermometer to permit temperature correction. Degees Brix was also determined with a Bausch and Lomb Abbe 3-L refractometer and corrected for temperature. Acid contents were determined by potentiometric titration with standardized sodium hydroxide solution to pH 8.2, as determined by a Corning model 7 pH meter, and reported as anhydrous citric acid. Color values for orange juice were determined using a MacBeth Examolite model EBA 220 lamp, with the revised color-tube standards OJ-2—OJ-6 (U.S. Agricultural Marketing Service 1976). Starting with the 1971–72 season, color values were also determined using a Hunter model D-45 citrus colorimeter standardized with an OJ-4 color-tube standard (furnished by the manufacturer) having *CR* and *CY* readings of 31.5 and 78.2, respectively. In order to correlate the two sets of color data more fully, all the OJ tube standards (OJ-1—OJ-6) in a set belonging to this (Agricultural Research Service) laboratory were run on the Hunter colorimeter for 3 successive days. Two other sets of OJ tube standards were borrowed from a local citrus processor, and each set was run on the Hunter instrument once. Hunter color scores were calculated from the formulas of Huggart et al. (1969) and Huggart and Wenzel (1972), where point scores$=22.510+0.165CR+0.111CY$. *CR* and *CY* are the respective red and yellow readings from the citrus colorimeter.

Grapefruit juice colors were determined using a Gardner color difference meter with an LR-1 standard. The juice was at least 1 inch deep in the sample cup. The R_d, a, and b readings were taken and the a/b ratio recorded. (A positive a/b ratio indicates grade A pink grapefruit juice; a negative ratio, usually resulting from a negative a reading, indicates a substandard juice.)

Suspended-solids (pulp) contents were determined by centrifuging 50 ml of well-agitated, deaerated juice in conical centrifuge tubes in an Internaticnal Equipment Co. (IEC) type 5B (size 1) centrifuge for 10 minutes at 1,300 r/min, doubling the obtained solids reading, and recording the result as a percentage by volume. Juice yields were obtained by dividing the weight of the juice after extraction and after a 70-second draining period by the weight of the fruit sample before extraction and recording the result as a percentage. Vitamin C measurements, which were begun in the 1969–70 season, were determined by the colorimetric

procedure of Nelson and Somers (1945) and recorded as milligrams of L-ascorbic acid per 100 ml of juice. Naringin contents were determined by the Davis (1974) procedure and reported as parts per million.

RESULTS AND DISCUSSION

Grove Locations

As indicated previously, grove locations were chosen to be representative of the Texas citrus production areas. Statistical correlation of grove locations with overall citrus maturity data indicated no significant differences in any of the five locations. These results were true for both oranges and grapefruit and implied that harvesting need not require any special planning sequence other than conditions imposed by time of ripening and minimum grade specifications.

'Marrs' Oranges

This variety of oranges is the earliest to mature. Table 1 presents the means and the standard deviations (σ) of the maturity characteristics for the five harvest seasons combined, and figures 1–7 present the monthly trends and variations in these characteristics. Acid content dropped rapidly, resulting in a high Brix/acid ratio fairly early in the season. At the beginning of the season, the Brix readings on the spindle were slightly higher than on the refractometer, with the variance narrowing overall toward the end of the season. In some seasons, color was at least grade B initially and increased to nearly an OJ–2 depth late in the season. (Calculated Hunter score-point values above 40 must be considered as a score of only 40, since the USDA standards (U.S. Agricultural Marketing Service 1976) grant no more than 40 score points for color.) Juice yield values, with few exceptions, were in the 50%–60% range. Pulp content of the juice increased somewhat in volume toward the end of the season, an increase attributed to gradual softening of the fruit. Vitamin C content varied fairly widely, but a slight trend to peak at initial maturity, followed by a slow decline, occurred during some seasons. Variation of vitamin C content in citrus was discussed by Cohen (1953) and Nagy (1980).

'Hamlin' Oranges

Table 2 summarizes maturity data for the 'Hamlin' oranges. This variety generally has heavy yields in terms of tons of fruit per acre. Color is not only slow to develop but seldom reaches the depth present in 'Marrs' during a normal harvest season. In this study, degrees Brix, acid content, Brix/acid ratio, pulp content, and juice yield for 'Hamlin' were similar to those values for 'Marrs'. 'Hamlin' contained the highest concentration of vitamin C of any of the three orange cultivars, which was supported by Cruse and Lime (1977a). The monthly trends and variations in the maturity characteristics of 'Hamlin' oranges are shown in figures 8–14.

'Valencia' Oranges

Table 3 summarizes the maturity data for 'Valencia' oranges. This variety is late maturing but provides the deepest color of the three varieties during a normal harvest season. Though the flavedo is green, the inside flesh is seldom lighter than the OJ–5 standard at the start of the harvest season in late January or early February. In this study, degrees Brix for 'Valencia' varied less than for the early-season varieties, and the acid level remained more stable until the onset of senescence. However, there was a tendency for the acid level to drop and cause a higher Brix/acid ratio as the season progressed. Pulp levels for 'Valencia' were also less variable than those for the early-season oranges. Juice yield values for this variety were generally higher than those for the other varieties. Vitamin C content varied somewhat more in 'Valencia' than in the other two cultivars. At times it approached the levels in 'Hamlin' oranges but was generally lower in this vitamin than the latter. The monthly trends and variations in the maturity characteristics of 'Valencia' oranges are presented in figures 15–21.

'Ruby Red' Grapefruit

Degrees Brix readings varied less for this cultivar than for the oranges (table 4). The acid level dropped more slowly, but there was a gradual rise in the Brix/acid ratio. The highest

(Continued on page 6.)

Table 1.—Monthly means and standard deviations of the maturity characteristics of 'Marrs' oranges over five harvest seasons, 1969–73

Month	Degrees Brix		Acid content (%)	Brix/acid ratio[1]	Hunter color-score points	Juice yield (%)	Suspended-solids content[2] (%)	Vitamin C content (mg/100 ml)
	Spindle	Refractometer						
September	11.3±0.9	11.1±1.0	0.94±0.18	11.9±2.6	32.11±0.62	49.5±2.8	16.3±2.2	45.4±4.5
October	11.3±1.1	11.1±1.0	.79±0.19	14.7±3.3	33.56±0.70	52.8±3.2	15.6±2.2	41.0±8.4
November	11.8±1.1	11.7±1.1	.63±0.10	19.0±3.2	35.76±1.43	55.0±3.1	18.6±2.5	38.0±5.5
December.....	12.5±1.0	12.5±1.0	.58±0.10	21.7±3.2	37.56±0.94	54.4±3.2	20.6±3.8	39.0±3.5
January	13.5±1.1	13.4±1.1	.56±0.11	24.3±4.2	38.75±0.81	53.5±2.9	23.0±3.1	35.9±5.2
February	14.2±1.0	14.1±1.0	.51±0.10	28.2±4.6	39.51±0.59	52.2±3.2	23.6±3.1	33.9±3.8
March.....	15.0±1.1	14.4±1.1	.49±0.10	30.4±4.7	40.87±0.71	51.5±4.7	22.1±2.5	30.0±5.1
April.....	15.2±1.1	15.2±1.2	.45±0.04	33.9±4.3	40.97±0.79	49.1±4.2	25.1±1.1	35.0±9.7
May	15.7±1.1	15.6±1.1	.47±0.01	33.4±3.3	41.68±0.82	47.0±1.4	26.0±1.0	27.0±4.2

[1]Refractometer value used.
[2]Pulp content.

Table 2.—Monthly means and standard deviations of the maturity characteristics of 'Hamlin' oranges over five harvest seasons, 1969–73

Month	Degrees Brix		Acid content (%)	Brix/acid ratio[1]	Hunter color-score points	Juice yield (%)	Suspended-solids content[2] (%)	Vitamin C content (mg/100 ml)
	Spindle	Refractometer						
September	11.0±1.0	10.7±0.9	1.18±0.25	9.4±2.5	31.61±0.87	47.2±6.2	16.5±1.8	42.4±15.9
October	10.8±0.9	10.7±0.9	1.00±0.20	11.2±2.9	32.05±0.85	51.5±3.6	15.6±1.7	51.2± 5.6
November	11.3±0.9	11.1±0.9	.80±0.13	14.3±2.8	34.00±1.60	53.8±4.3	18.4±2.3	46.8± 4.7
December.....	12.0±1.0	11.8±0.9	.74±0.09	16.0±2.2	35.39±1.58	54.0±3.4	20.0±1.9	47.5± 5.4
January	13.0±1.0	13.0±0.9	.70±0.09	18.2±2.3	36.45±1.55	53.0±3.6	22.0±2.4	48.0± 6.0
February	14.0±1.0	13.5±1.0	.67±0.08	20.6±2.8	36.98±0.83	53.0±4.0	24.0±3.0	50.0± 3.7
March.....	14.2±1.2	14.2±1.2	.64±0.09	23.0±3.1	38.19±1.28	52.2±5.4	23.0±3.0	44.0± 7.2
April.....	14.3±2.0	14.3±1.6	.61±0.06	24.0±3.1	37.58±1.06	49.0±5.0	24.0±2.1	50.0± 8.4
May	13.6±0.3	14.0±0.3	.58±0.08	23.5±2.5	38.22±1.29	51.0±5.6	23.0±2.3	27.3± 2.3

[1]Refractometer value used.
[2]Pulp content.

Table 3.—Monthly means and standard deviations of the maturity characteristics of 'Valencia' oranges over five harvest seasons, 1969–73

Month	Degrees Brix		Acid content (%)	Brix/acid ratio[1]	Hunter color-score points	Juice yield (%)	Suspended-solids content[2] (%)	Vitamin C content (mg/100 ml)
	Spindle	Refractometer						
January	12.3±0.7	12.1±0.6	1.20±0.18	10.3±1.5	37.53±0.82	58.0±2.6	18.1±1.7	43.7±7.3
February	12.6±0.7	12.4±0.6	1.08±0.15	11.7±1.6	38.47±0.66	58.4±3.1	19.0±1.9	37.4±7.0
March	13.2±0.9	13.0±0.8	.95±0.16	14.1±2.1	40.18±1.15	58.9±4.2	19.2±2.5	39.0±6.8
April	13.5±0.9	13.4±0.9	.79±0.14	17.4±2.8	40.01±0.79	60.0±2.9	19.5±2.0	38.3±6.0
May	13.6±1.0	13.6±1.0	.72±0.13	19.5±3.3	40.34±0.95	58.8±4.4	18.3±1.5	34.0±6.3
June	13.4±1.1	13.4±1.0	.60±0.18	25.0±9.8	40.94±0.61	60.0±3.6	19.3±1.6	28.7±4.8

[1]Refractometer value used.
[2]Pulp content.

Table 4.—Monthly means and standard deviations of the maturity characteristics of 'Ruby Red' grapefruit over five harvest seasons, 1969–73

Month	Degrees Brix		Acid content (%)	Brix/acid ratio[1]	Gardner *a*/*b* color ratio[2]	Juice yield (%)	Suspended-solids content[3] (%)	Vitamin C content (mg/100 ml)	Naringin content (p/m)
	Spindle	Refractometer							
October	10.9±1.1	10.8±1.0	1.58±0.18	6.9±0.5	0.42±0.25	48.8±3.3	11.3±1.4	34.8±5.9	150.0±15.1
November	10.7±1.0	10.6±1.0	1.51±0.17	7.1±0.7	.23±0.11	51.1±3.6	12.6±1.9	33.6±3.2	152.9+28.1
December	10.9±0.9	10.7±0.9	1.45±0.15	7.5±0.6	.17±0.10	53.2±2.9	13.6±1.6	33.4±4.6	166.3±35.2
January	11.1±0.8	11.0±0.7	1.39±0.13	7.9±0.6	.18±0.14	54.6±1.9	13.4±2.0	31.1±4.3	165.5±42.7
February	11.1±0.7	10.9±0.7	1.30±0.13	8.4±0.7	.16±0.14	55.6±2.7	14.5±1.7	32.7±6.7	173.3±43.6
March	11.1±0.7	11.0±0.7	1.17±0.13	9.1±1.8	.13±0.13	56.4±2.7	13.9±1.3	31.2±4.9	170.5±29.8
April	11.0±0.7	10.9±0.7	1.10±0.16	10.1±1.5	.13±0.13	55.3±3.3	14.4±1.8	29.9±3.3	161.0±45.0
May	11.1±0.7	10.9±0.7	.99±0.17	11.3±1.8	.13±0.13	55.3±3.3	14.1±1.7	27.0±4.0	154.9±50.1
June	11.0±0.8	10.9±0.6	.89±0.18	12.7±2.7	.10±0.13	57.3±5.2	15.6±2.8	28.2±2.8	. . . . .

[1]Refractometer value used.
[2]All color ratio means are positive.
[3]Pulp content.

Table 5.—Results of running USDA and local-processor color-tube standards on the Hunter citrus colorimeter[1]

Sample source and trial or set No.	Tube No.	*CR*	*CY*	Score points
USDA, trial 1	OJ-6	21.1	72.9	34.08
	OJ-5	29.1	76.4	35.79
	OJ-4	31.2	77.8	36.29
	OJ-3	35.2	81.7	37.39
	OJ-2	40.9	81.8	38.34
	OJ-1	58.0	84.3	41.44
USDA, trial 2	OJ-6	21.3	73.1	34.14
	OJ-5	29.1	76.4	35.79
	OJ-4	30.9	78.0	36.27
	OJ-3	34.8	81.5	37.30
	OJ-2	40.9	81.8	41.54
	OJ-1	58.4	84.6	41.54
USDA, trial 3	OJ-6	21.1	73.1	34.14
	OJ-5	28.8	76.6	35.76
	OJ-4	30.9	77.9	36.26
	OJ-3	34.9	81.5	37.30
	OJ-2	40.9	81.8	38.34
	OJ-1	57.5	84.5	41.38
Local processor, set 1	OJ-6	21.3	73.1	34.14
	OJ-5	28.2	76.0	35.60
	OJ-4	31.0	78.3	36.32
	OJ-3	34.7	81.6	37.29
	OJ-2	40.8	81.4	38.28
	OJ-1	57.6	84.1	41.35
Local processor, set 2	OJ-6	21.1	72.4	34.03
	OJ-5	29.2	76.2	35.79
	OJ-4	31.1	77.8	36.28
	OJ-3	34.8	81.3	37.28
	OJ-2	40.4	80.5	38.11
	OJ-1	57.7	84.3	41.39

[1]OJ-4 tube standard by manufacturer had respective *CR* and *CY* values of 31.5 and 78.2 given as standard settings. *CR* and *CY* are the respective red and yellow readings from the citrus colorimeter.

ratio was 15.0, but the general trend was 10.0 or less.

Generally, Brix/acid ratios above 11 are found only in late-season fruit, sometimes after the normal harvest season has ended. Juice yields of grapefruit vary widely, as low as 41% in early-season fruit to as high as 72% in late-season fruit; thus, yields tend to rise as the season progresses. Vitamin C content varies somewhat less in grapefruit than in oranges and usually peaks at about 42 mg/100 ml of juice, but is generally lower. Color in pink grapefruit juice has long been a problem. The pink color fades during the season, and the juice takes on an amber hue. USDA's Food Safety and Quality Service (1980) has proposed that grapefruit juice be graded by

Table 6.—Monthly ranges of MacBeth color scores for Texas oranges over five harvest seasons, 1969–73

Month	'Marrs'	'Hamlin'	'Valencia'
September	−6, 6-5	−6, 6-5	.....
October	−6, 6-5	−6, 6-5	.....
November	−6, 6-4	−6, 6-5	.....
December	6-4	−6, 6-4	.....
January	6-3	6-3	6-3
February	6-3	6-3	5-3
March	6-3	6-3	4-3
April	3-2	4-3	4-2
May	3	4	4-2
June			3-2

factors other than white or pink color alone. The monthly trends and variations in the maturity characteristics of 'Ruby' Red' grapefruit are shown in figures 22–29.

Color Analyses of Orange Juice

Because of the nature of the OJ tube standards used in the MacBeth lamp, it was not possible to analyze the color ranges of orange juice statistically. As indicated in the Materials and Methods section, several sets of OJ tube standards, ranging from OJ-6 (lightest) to OJ-1 (darkest), were run in the Hunter citrus colorimeter. Table 5 summarizes results obtained while running the standards set belonging to this (Agricultural Research Service) laboratory on 3 consecutive days and while running two sets from a local processor once each. We believe the variations to be within normal limits of experimental error.

Ranges of MacBeth color scores by months over five harvest seasons for each of the three orange varieties are summarized in table 6. The term "−6" means that the color of the sample as viewed in the MacBeth lamp was not as good as that of the OJ-6 tube standard. The ranges (example: 6-5) indicate that the sample color was equal to or better than the higher numbered tube standard (6) but was not as good as the lower numbered tube standard (5). Where only one number was given, the juice color was equal to the color of the tube-standard number.

Despite the greater accuracy of the Hunter instrument (Cruse and Lime 1974b), it is not used

to any extent in the Texas citrus industry. The MacBeth lamp is still used officially by the Food Safety and Quality Service in the Texas citrus producing area.

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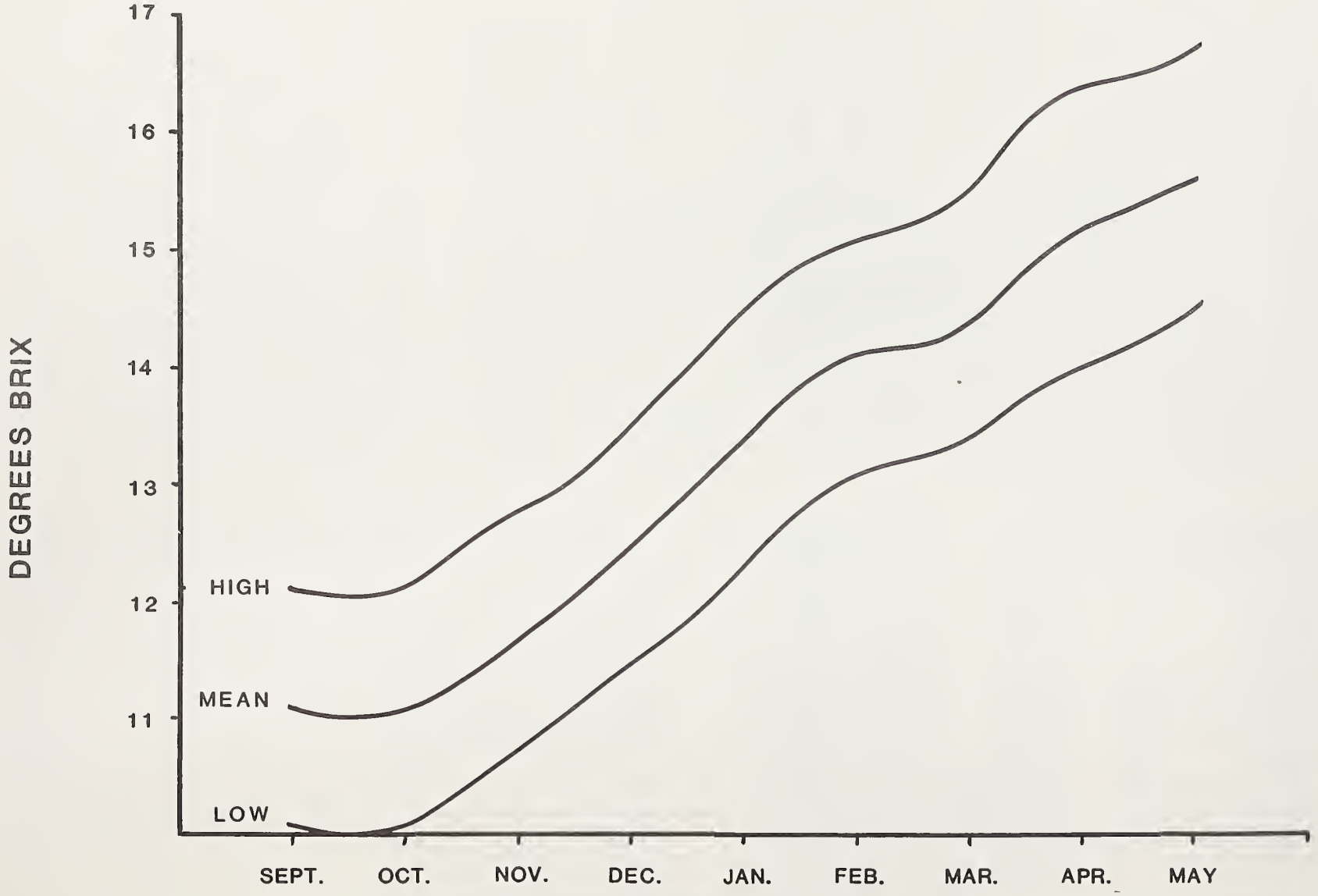

FIGURE 1.—Monthly trends and variations in degrees Brix for 'Marrs' oranges.

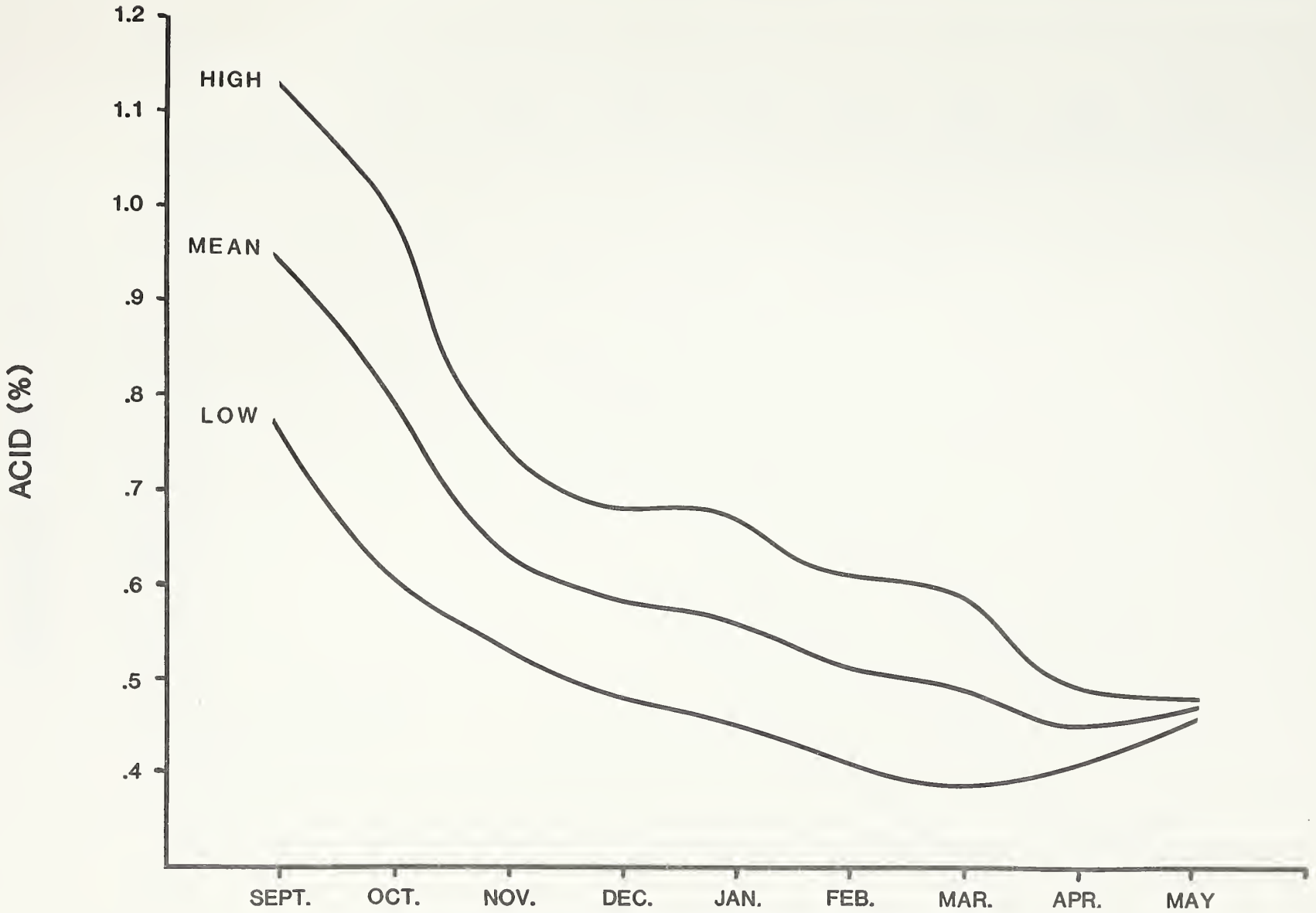

FIGURE 2.—Monthly trends and variations in percentage of acid in 'Marrs' oranges.

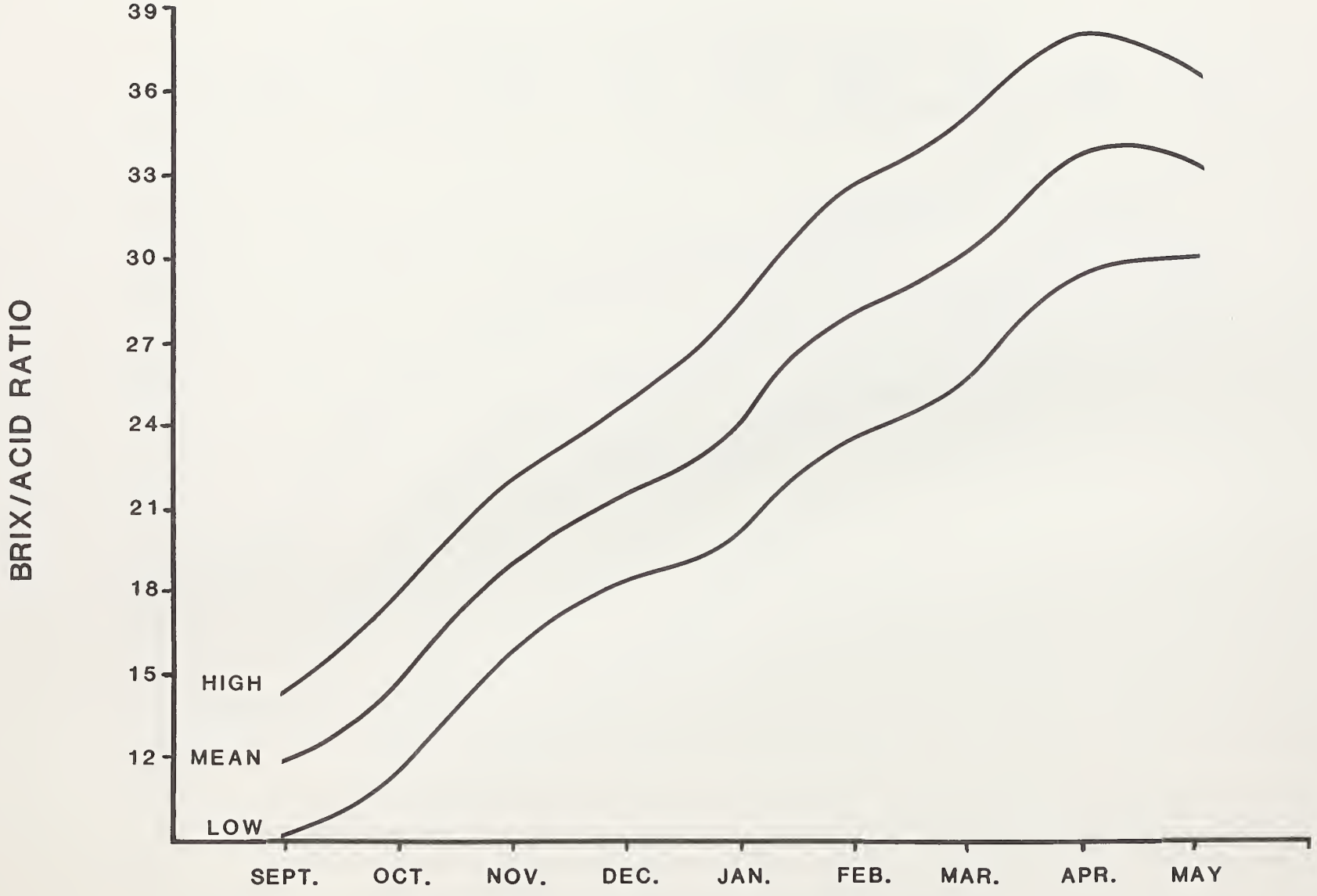

FIGURE 3.—Monthly trends and variations in Brix/acid ratio for 'Marrs' oranges.

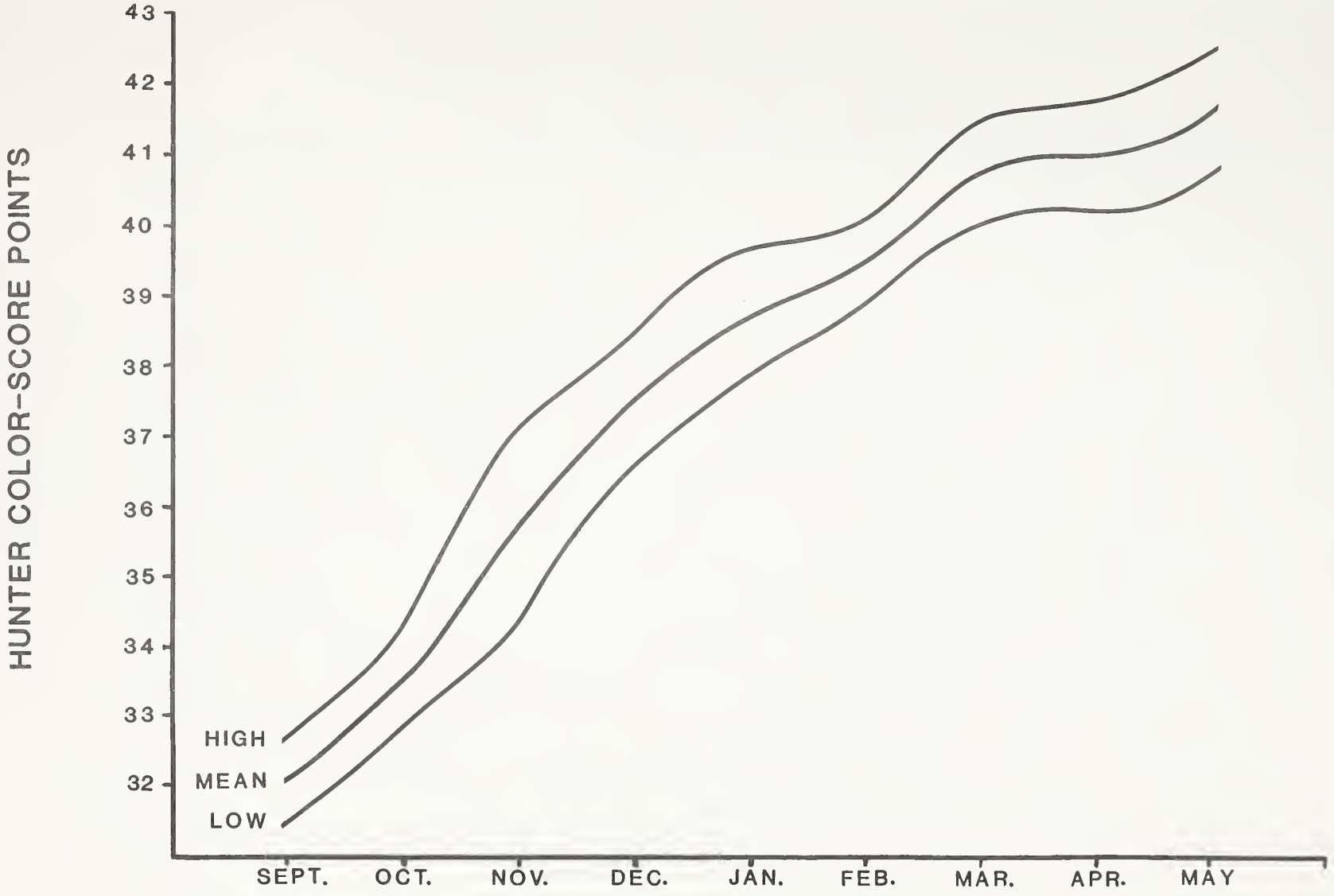

FIGURE 4.—Monthly trends and variations in color-score points for 'Marrs' oranges.

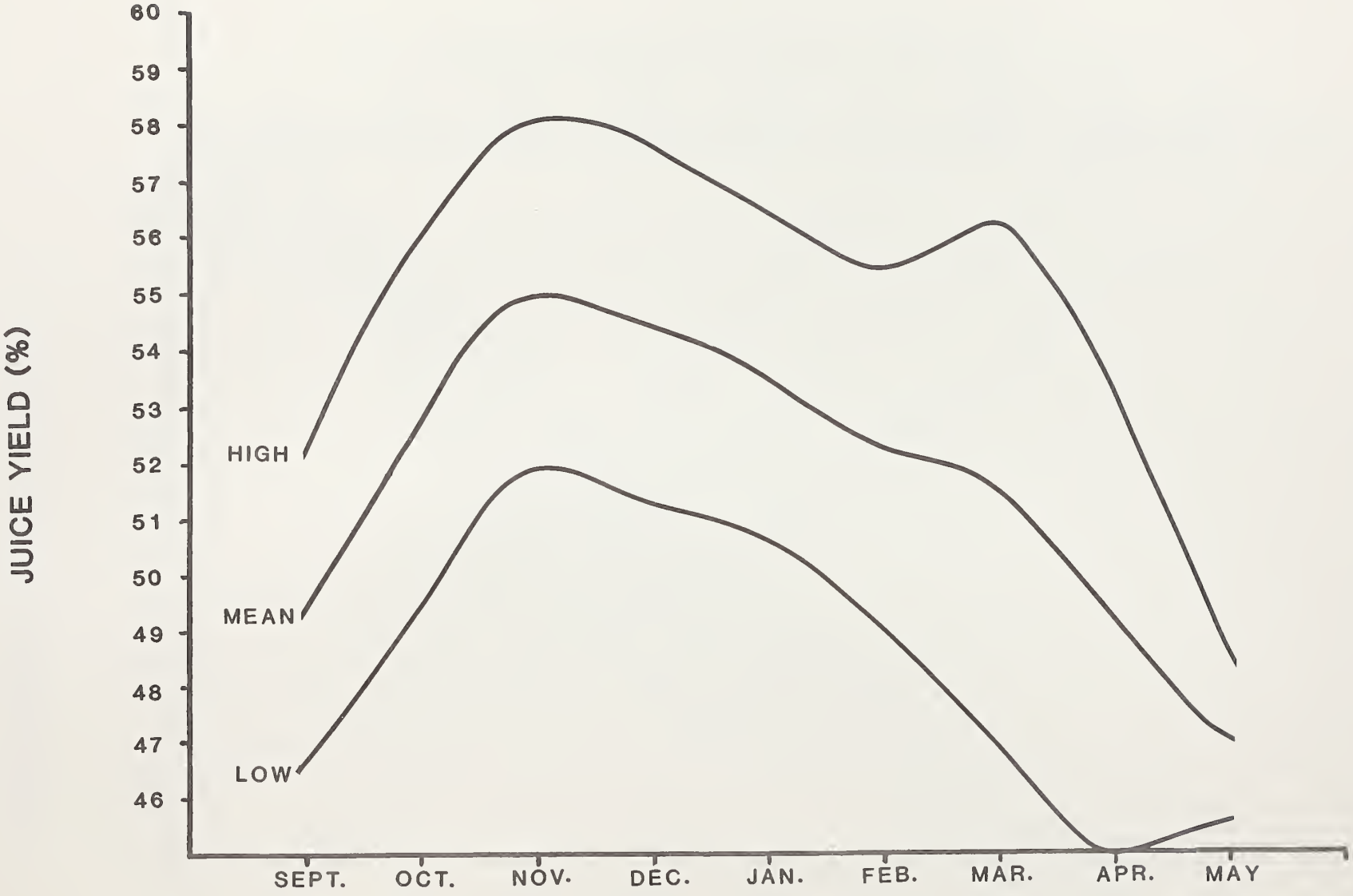

FIGURE 5.—Monthly trends and variations in percentage of juice from 'Marrs' oranges.

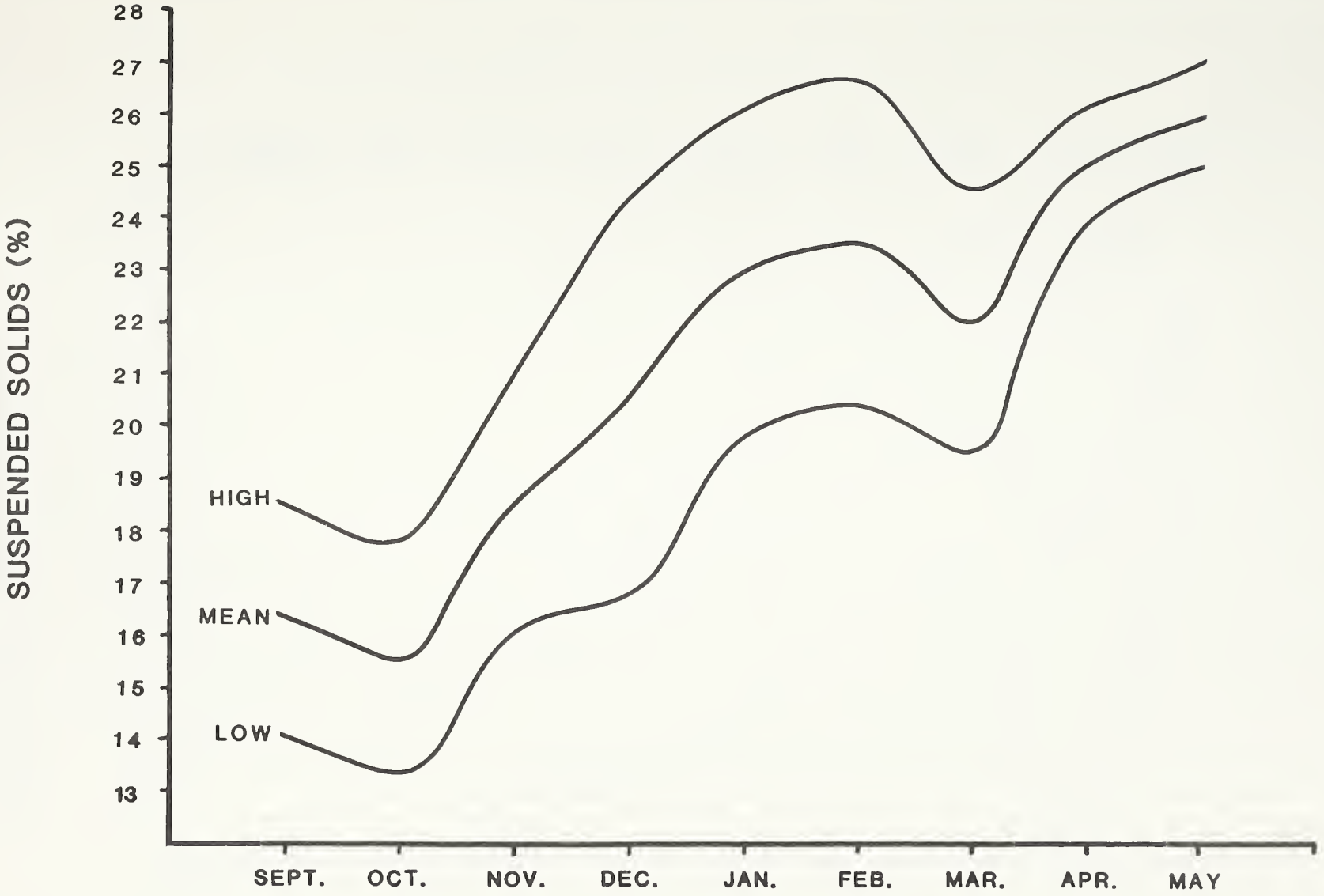

FIGURE 6.—Monthly trends and variations in percentage of suspended solids in 'Marrs' oranges.

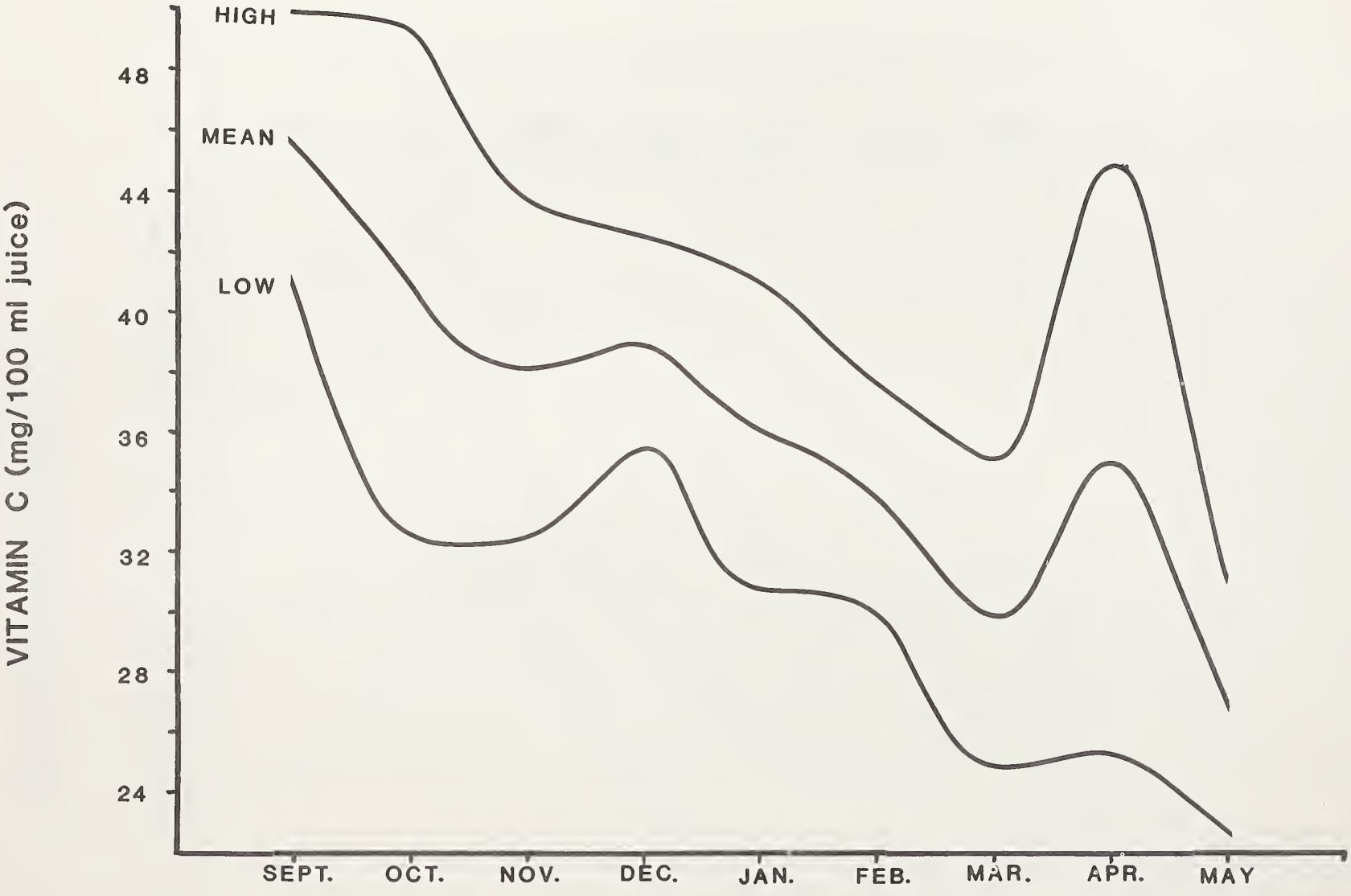

FIGURE 7.—Monthly trends and variations in vitamin C content of 'Marrs' oranges.

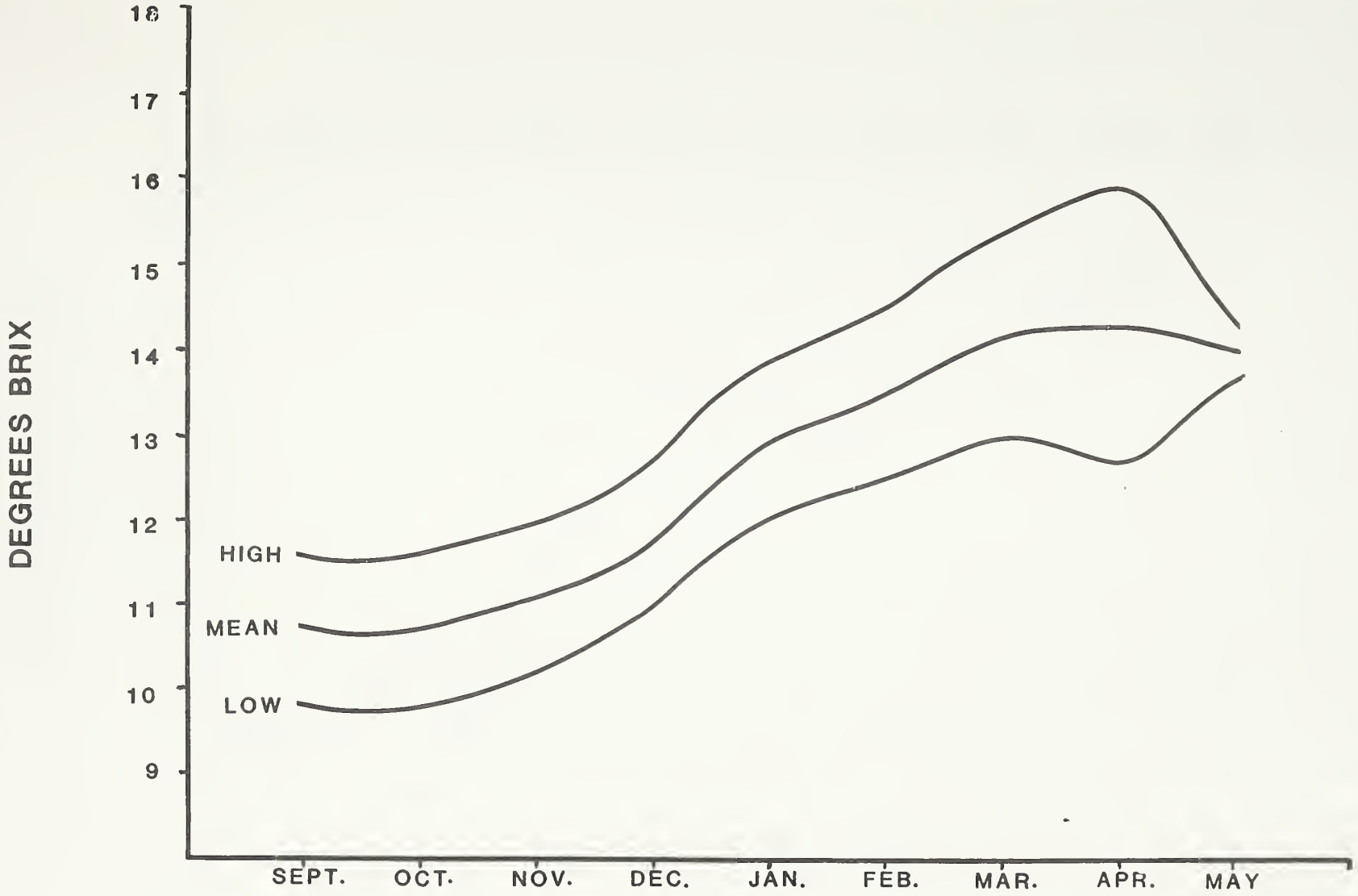

FIGURE 8.—Monthly trends and variations in degrees Brix for 'Hamlin' oranges.

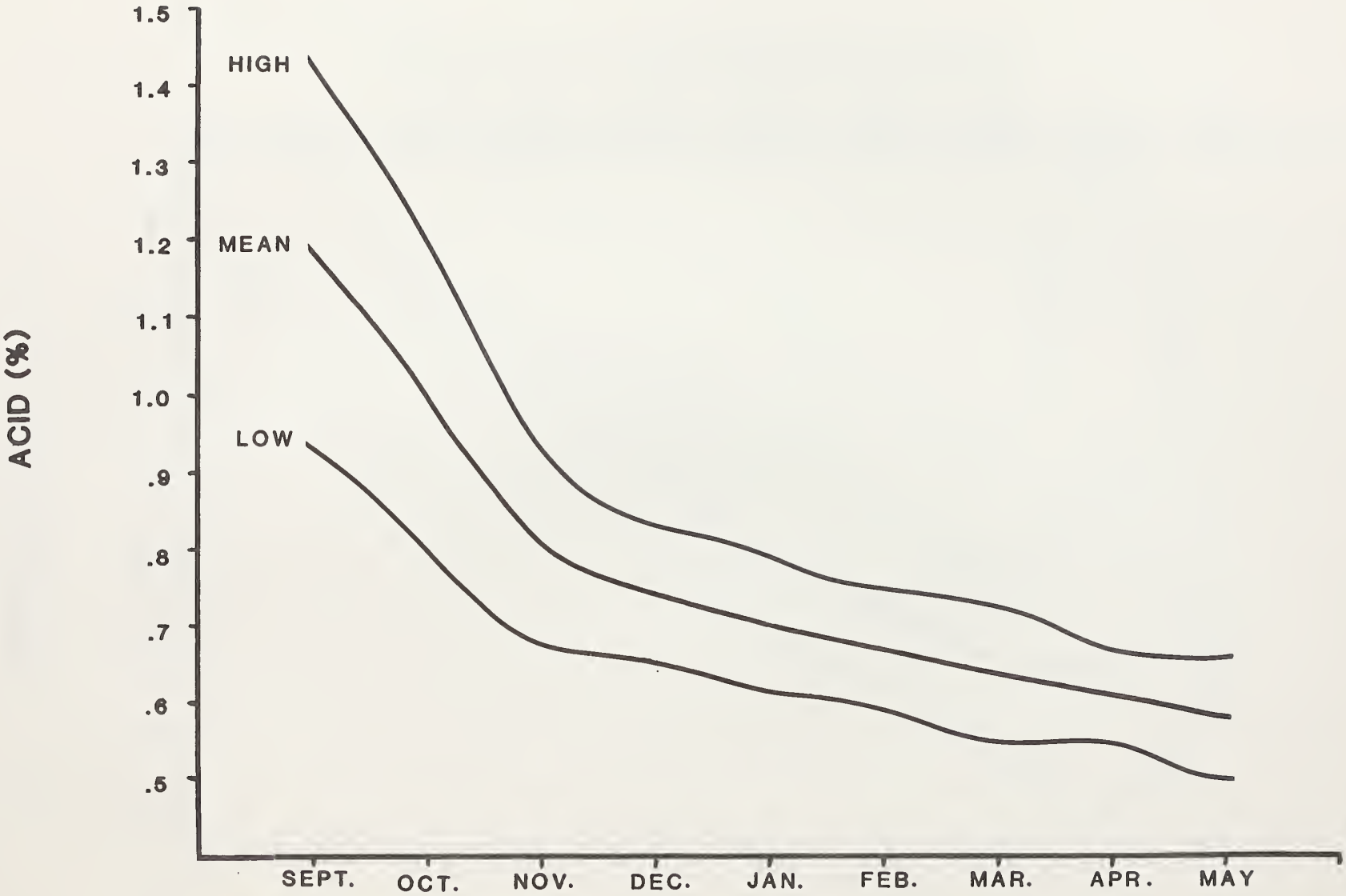

FIGURE 9.—Monthly trends and variations in percentage of acid in 'Hamlin' oranges.

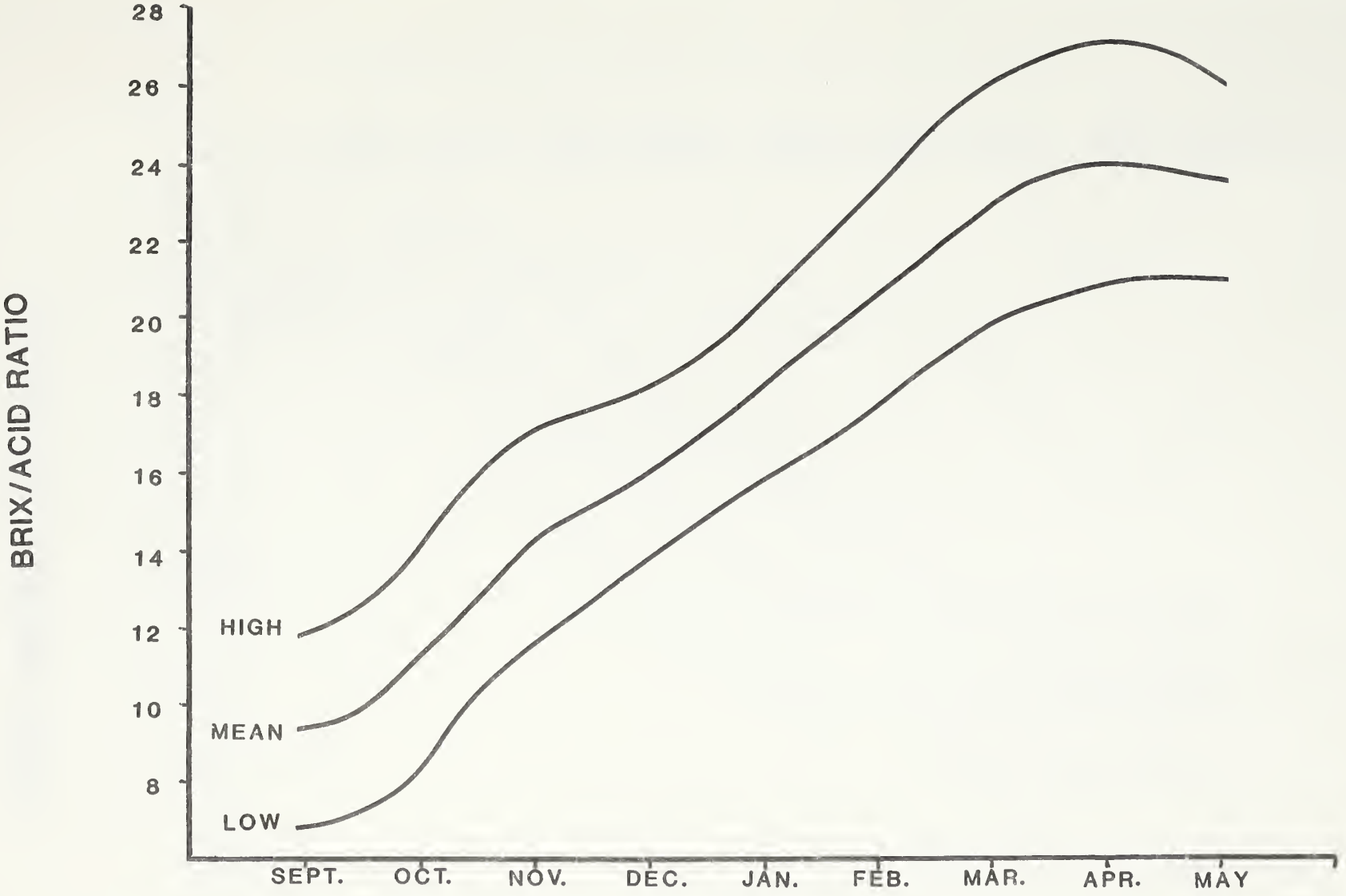

FIGURE 10.—Monthly trends and variations in Brix/acid ratio for 'Hamlin' oranges.

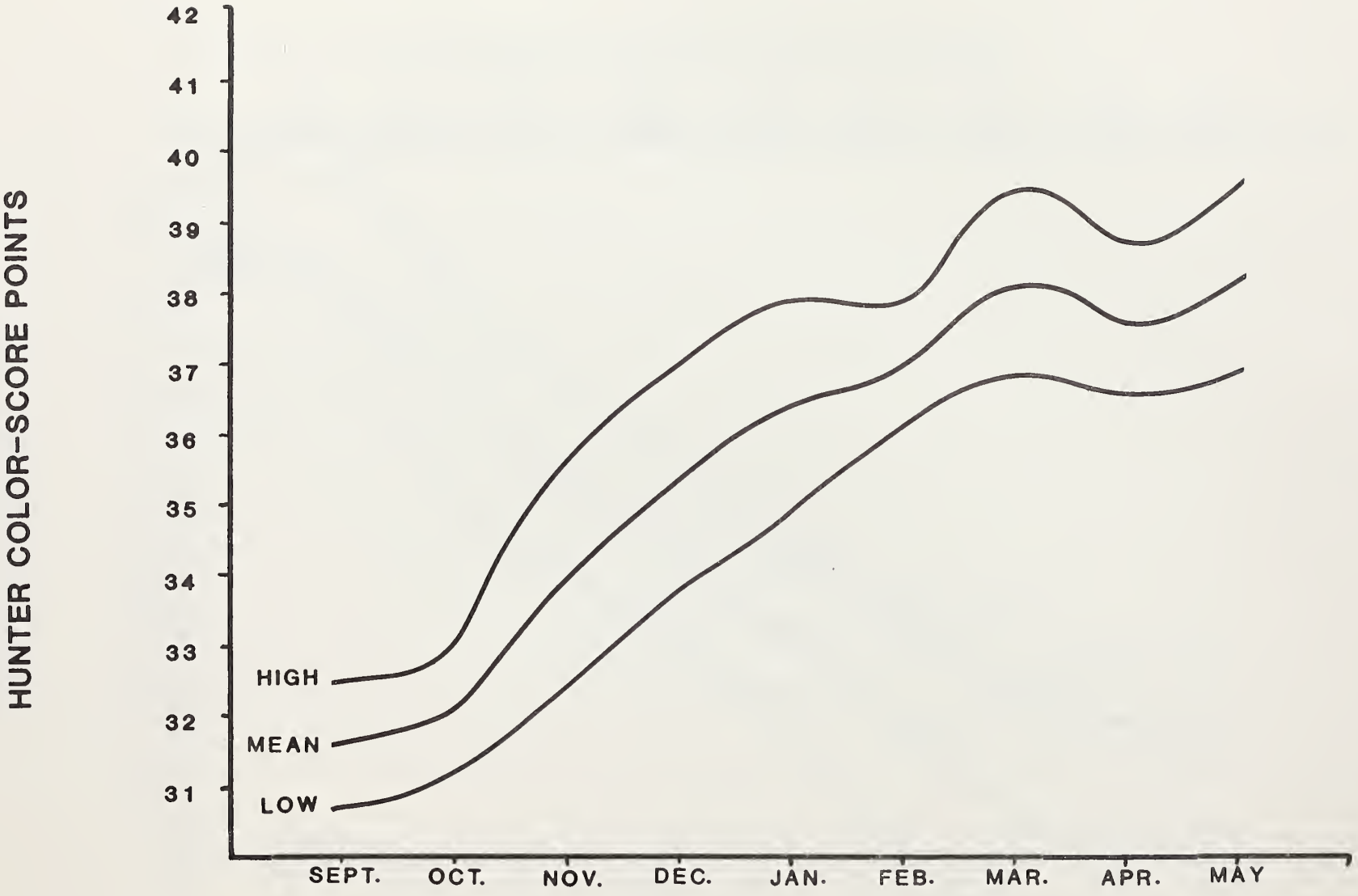

FIGURE 11.—Monthly trends and variations in color-score points for 'Hamlin' oranges.

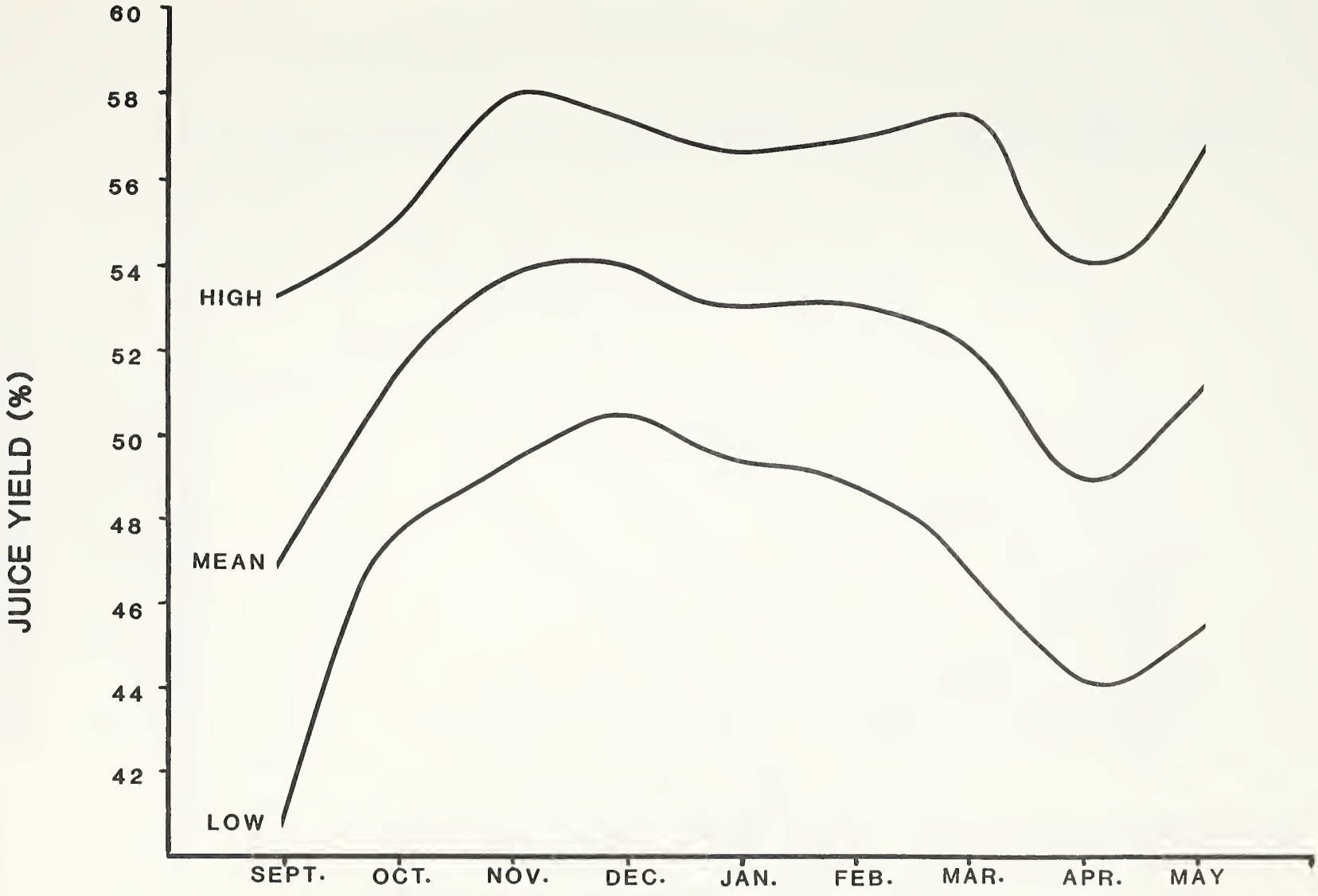

FIGURE 12.—Monthly trends and variations in percentage of juice from 'Hamlin' oranges.

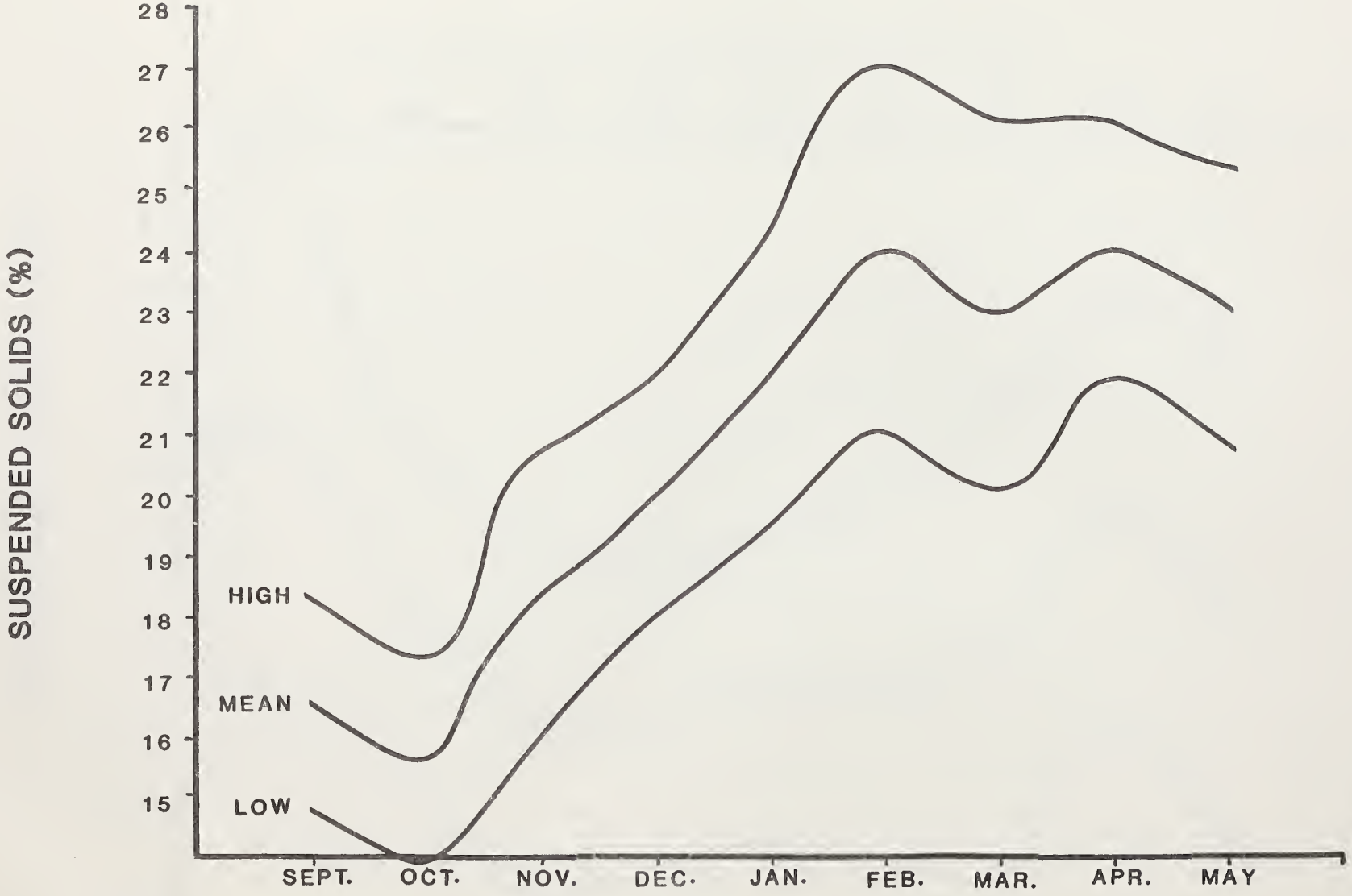

FIGURE 13.—Monthly trends and variations in percentage of suspended solids in 'Hamlin' oranges.

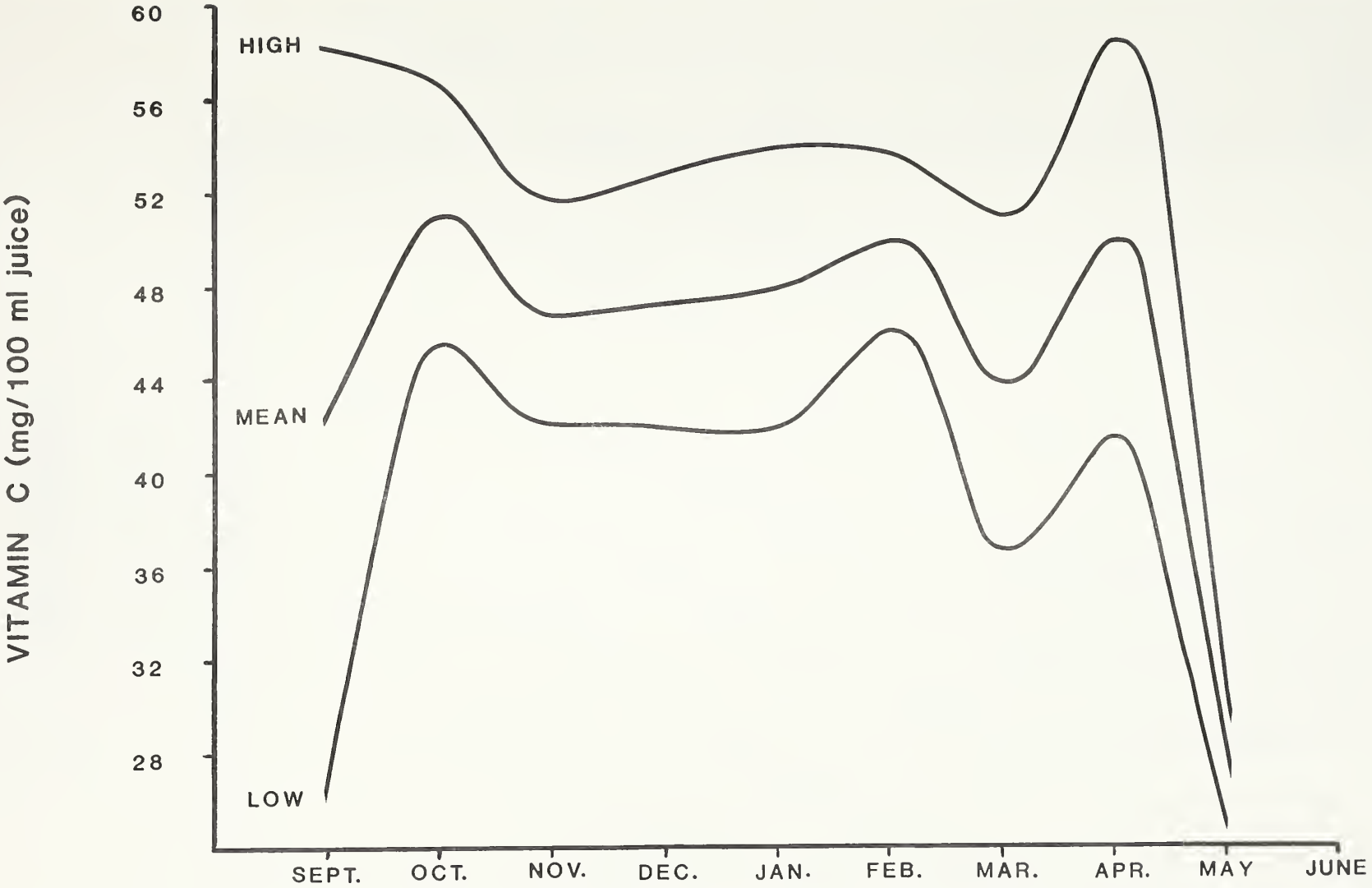

FIGURE 14.—Monthly trends and variations in vitamin C content of 'Hamlin' oranges.

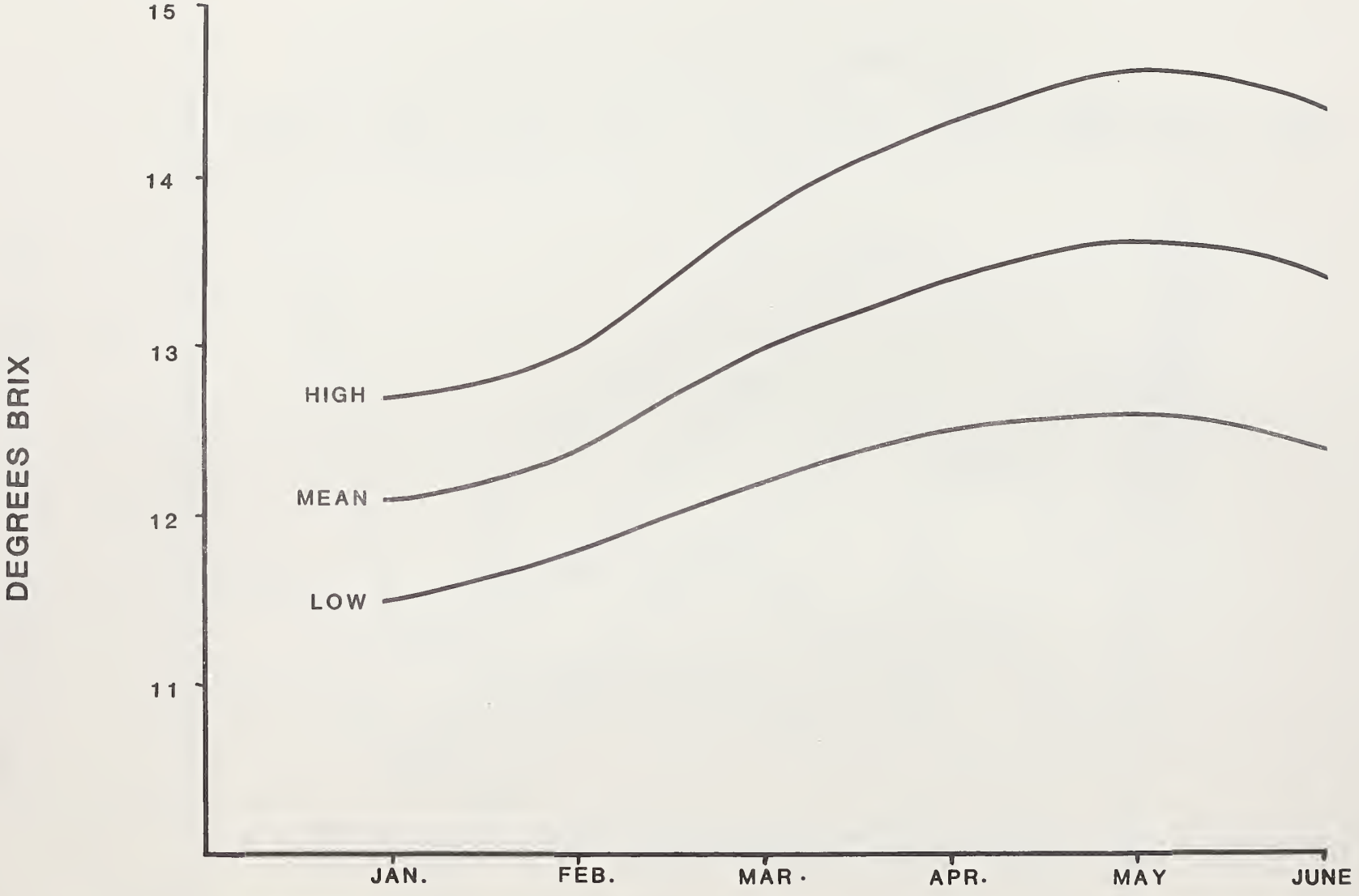

FIGURE 15.—Monthly trends and variations in degrees Brix for 'Valencia' oranges.

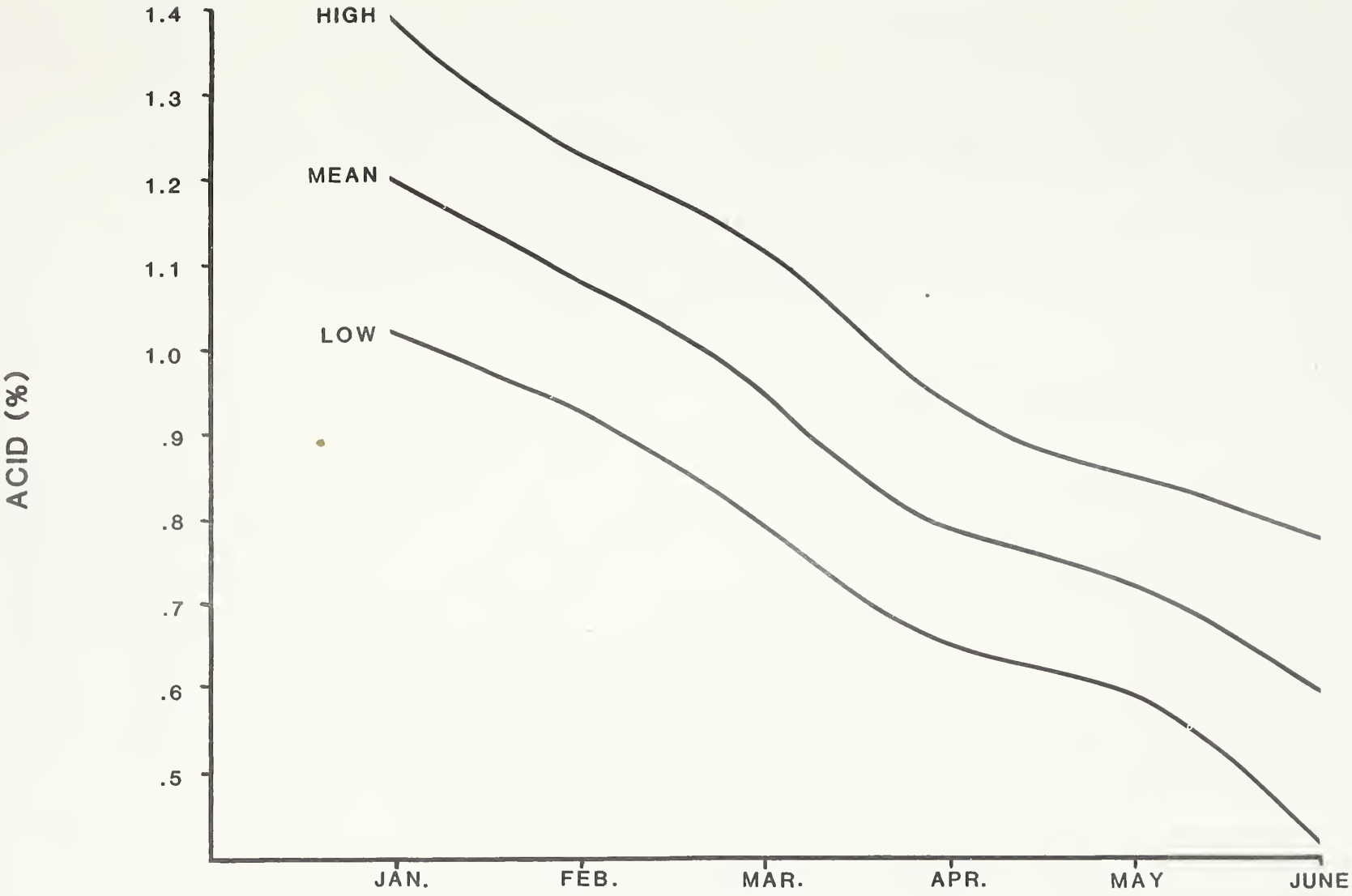

FIGURE 16.—Monthly trends and variations in percentage of acid in 'Valencia' oranges.

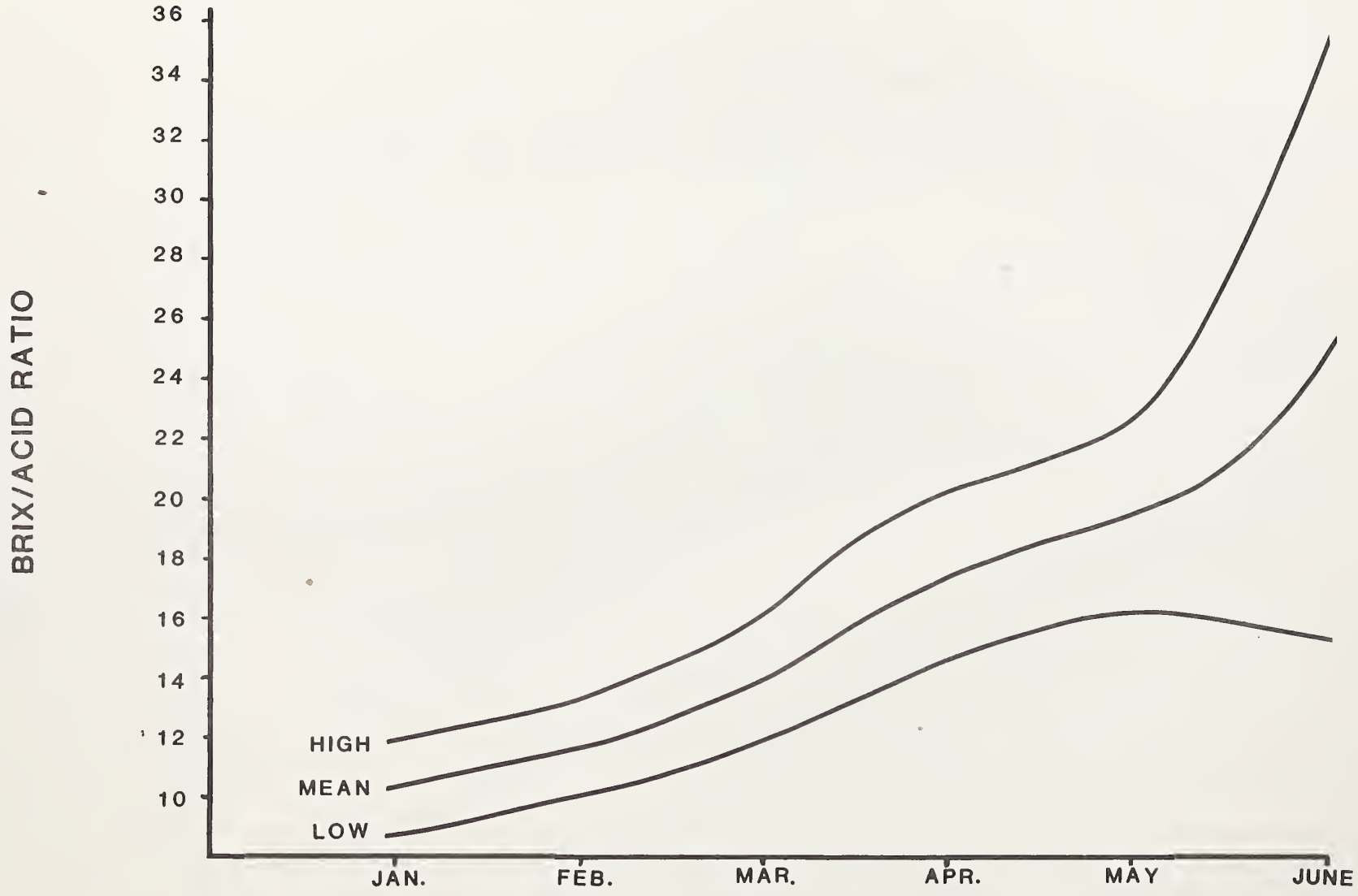

FIGURE 17.—Monthly trends and variations in Brix/acid ratio for 'Valencia' oranges.

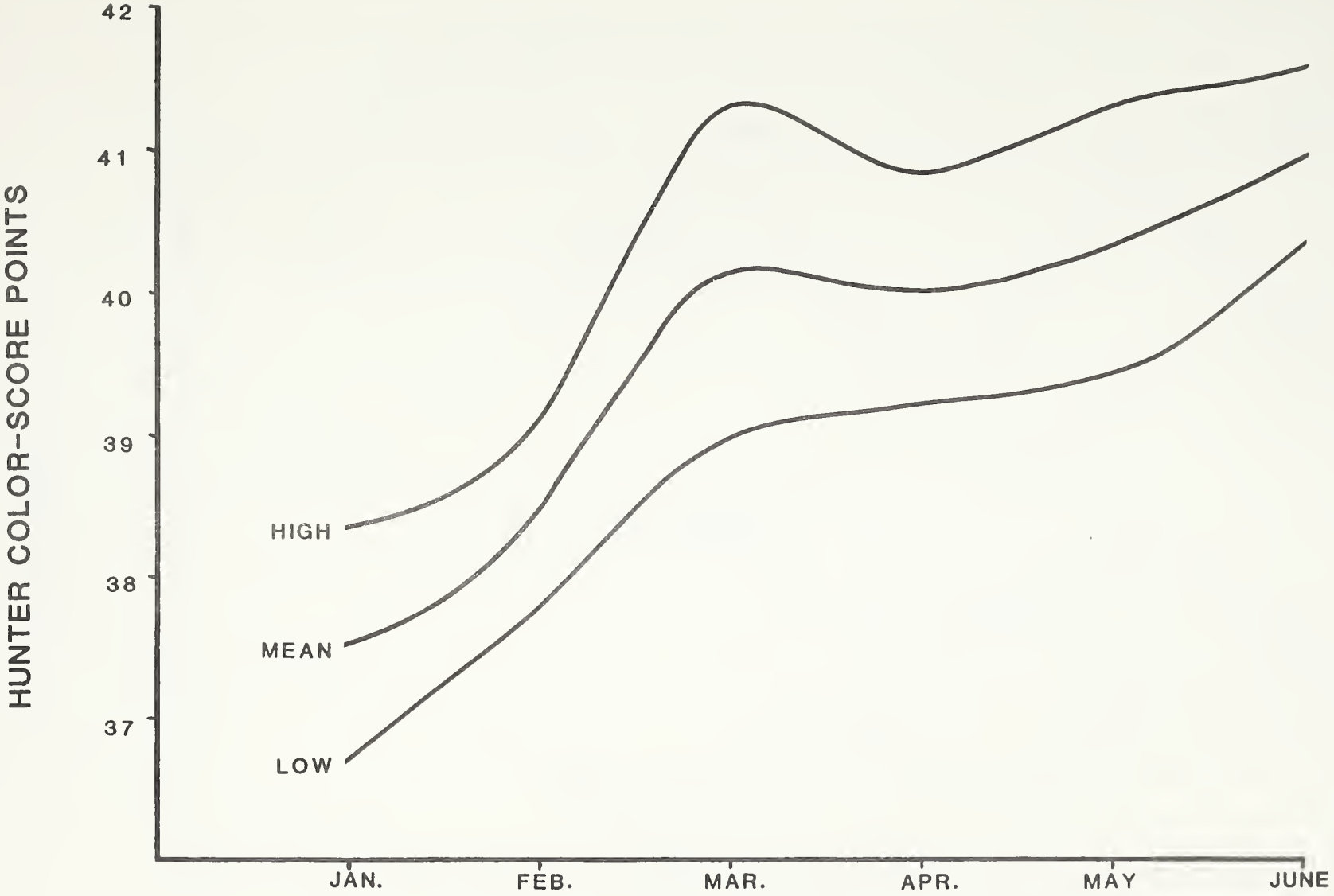

FIGURE 18.—Monthly trends and variations in color-score points for 'Valencia' oranges.

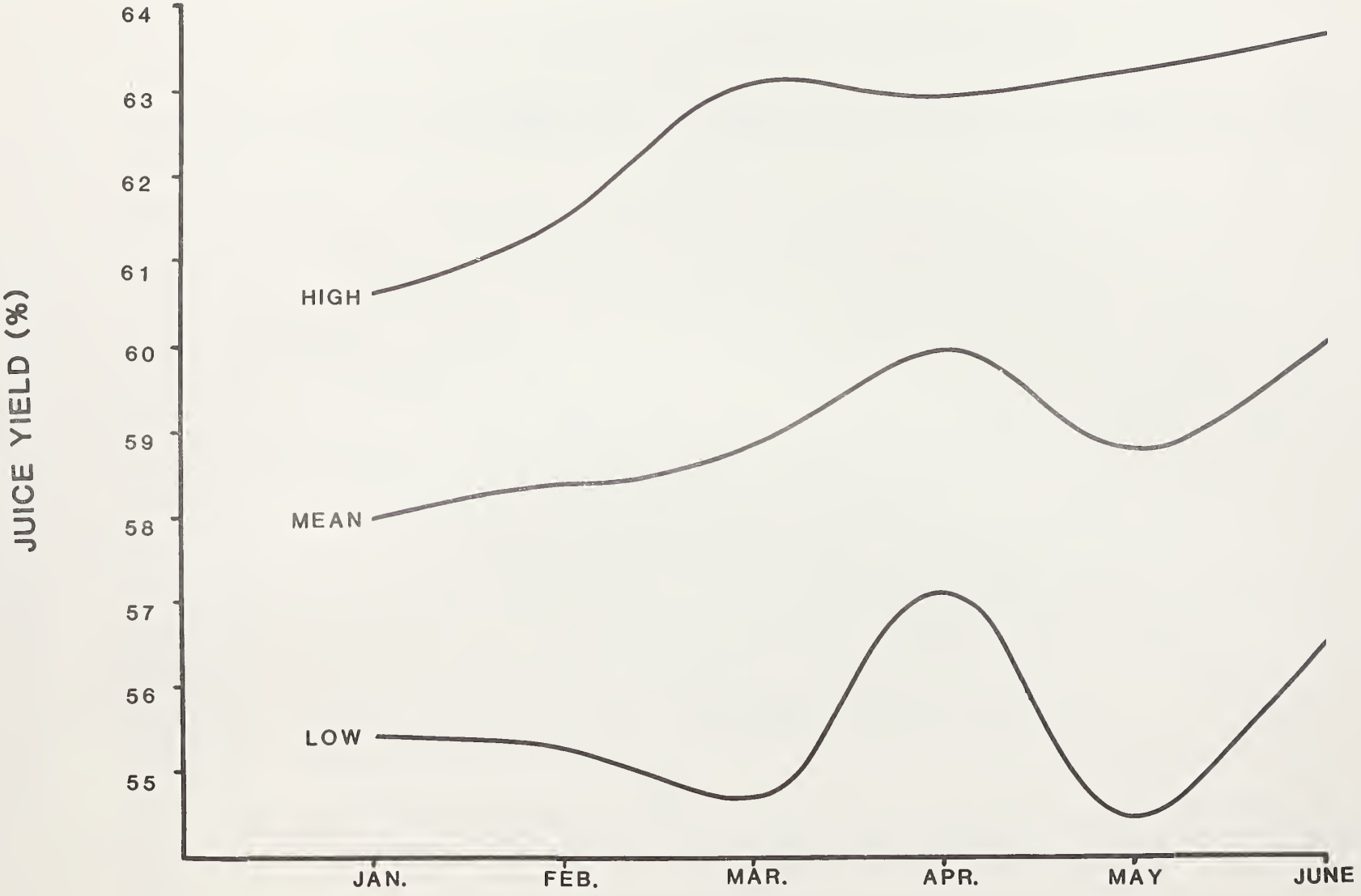

FIGURE 19.—Monthly trends and variations in percentage of juice from 'Valencia' oranges.

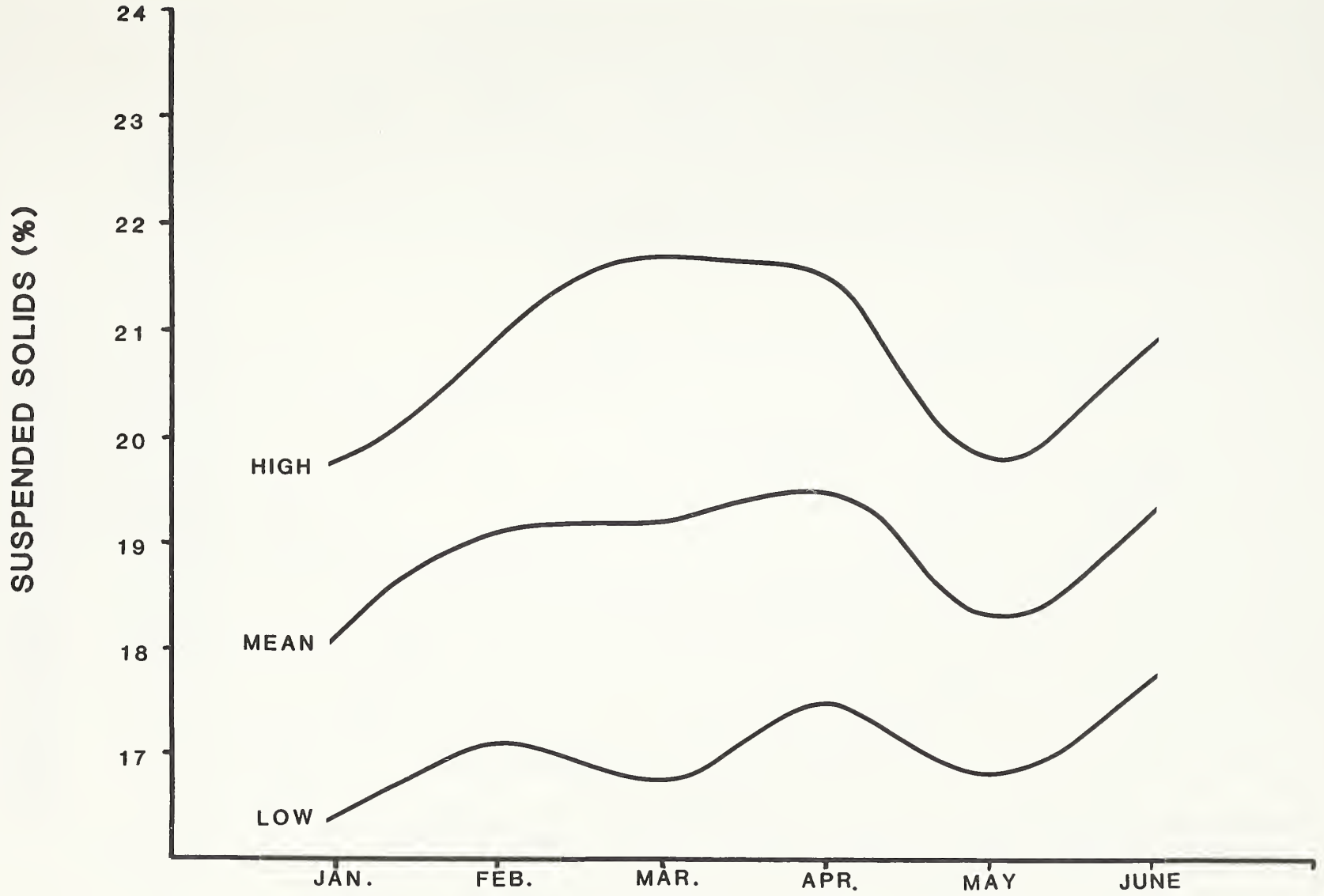

FIGURE 20.—Monthly trends and variations in percentage of suspended solids in 'Valencia' oranges.

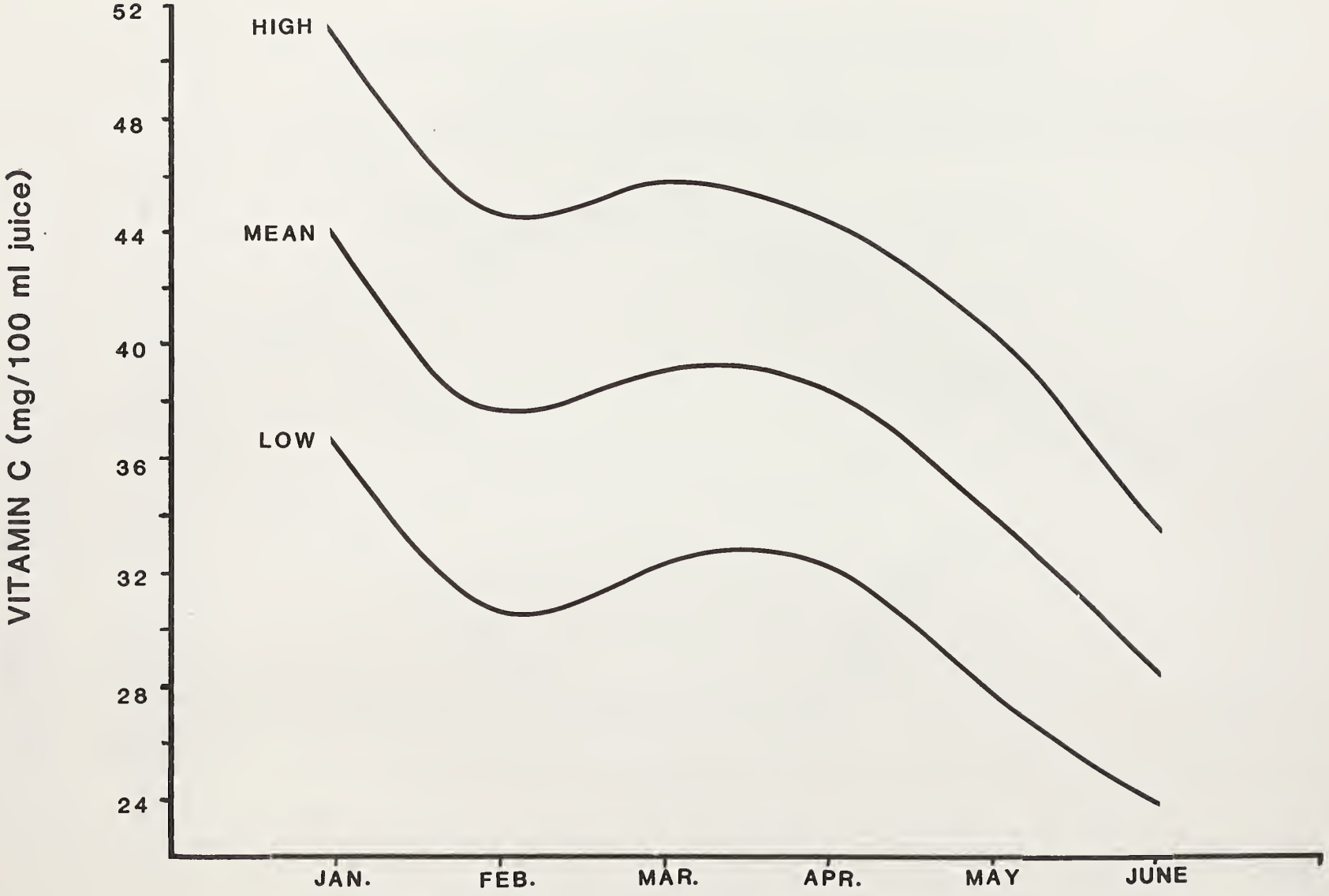

FIGURE 21.—Monthly trends and variations in vitamin C content of 'Valencia' oranges.

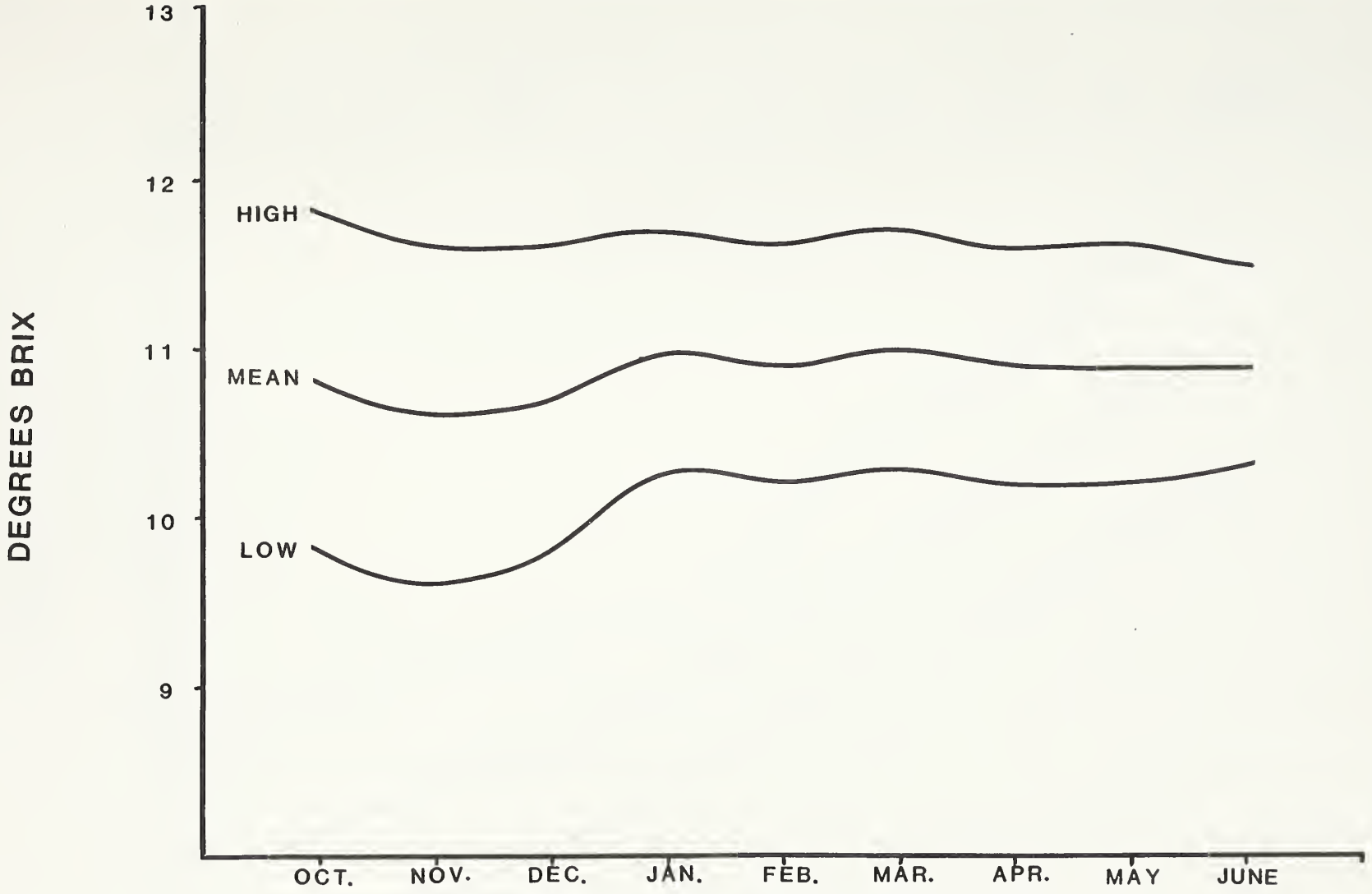

FIGURE 22.—Monthly trends and variations in degrees Brix for 'Ruby Red' grapefruit.

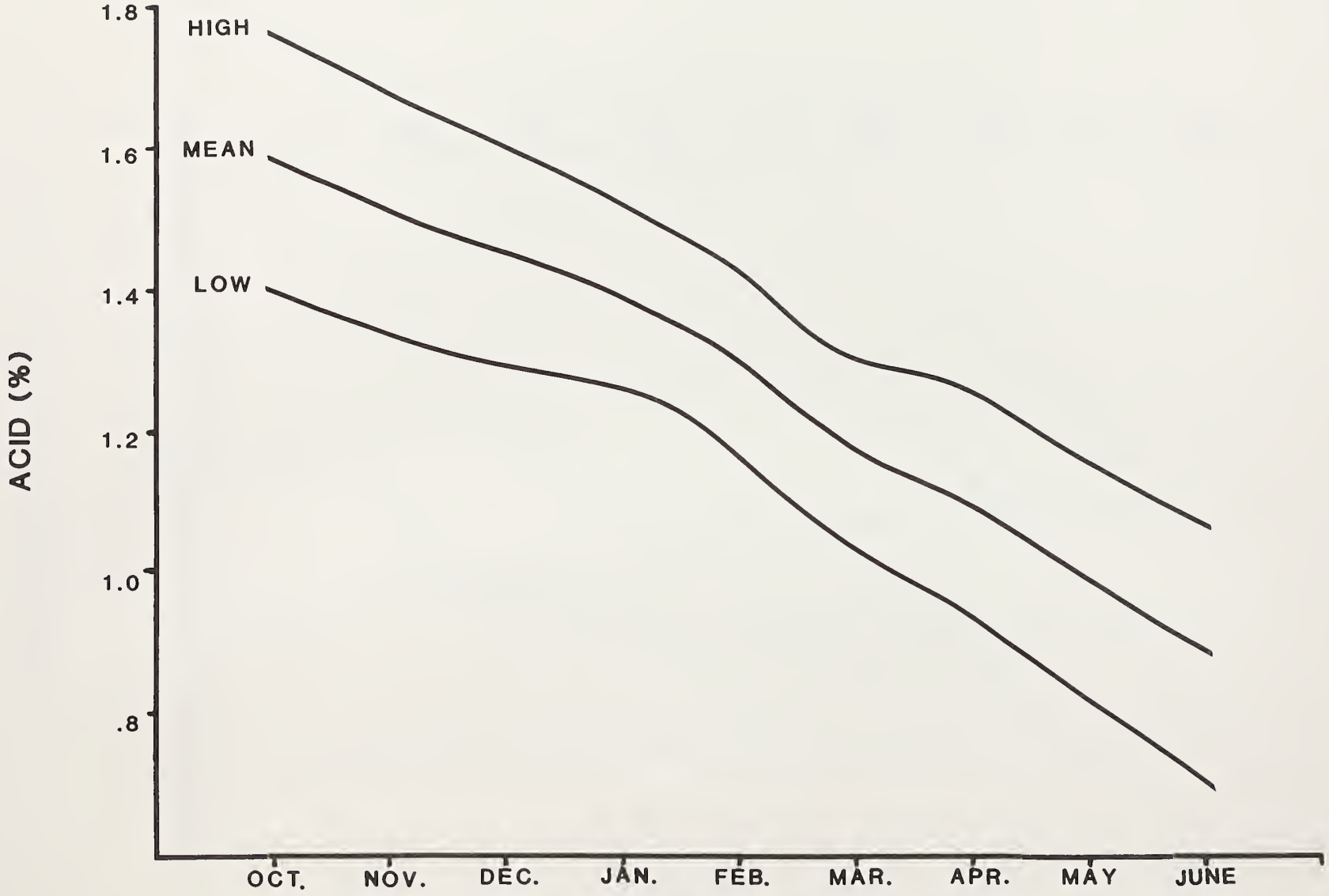

FIGURE 23.—Monthly trends and variations in percentage of acid in 'Ruby Red' grapefruit.

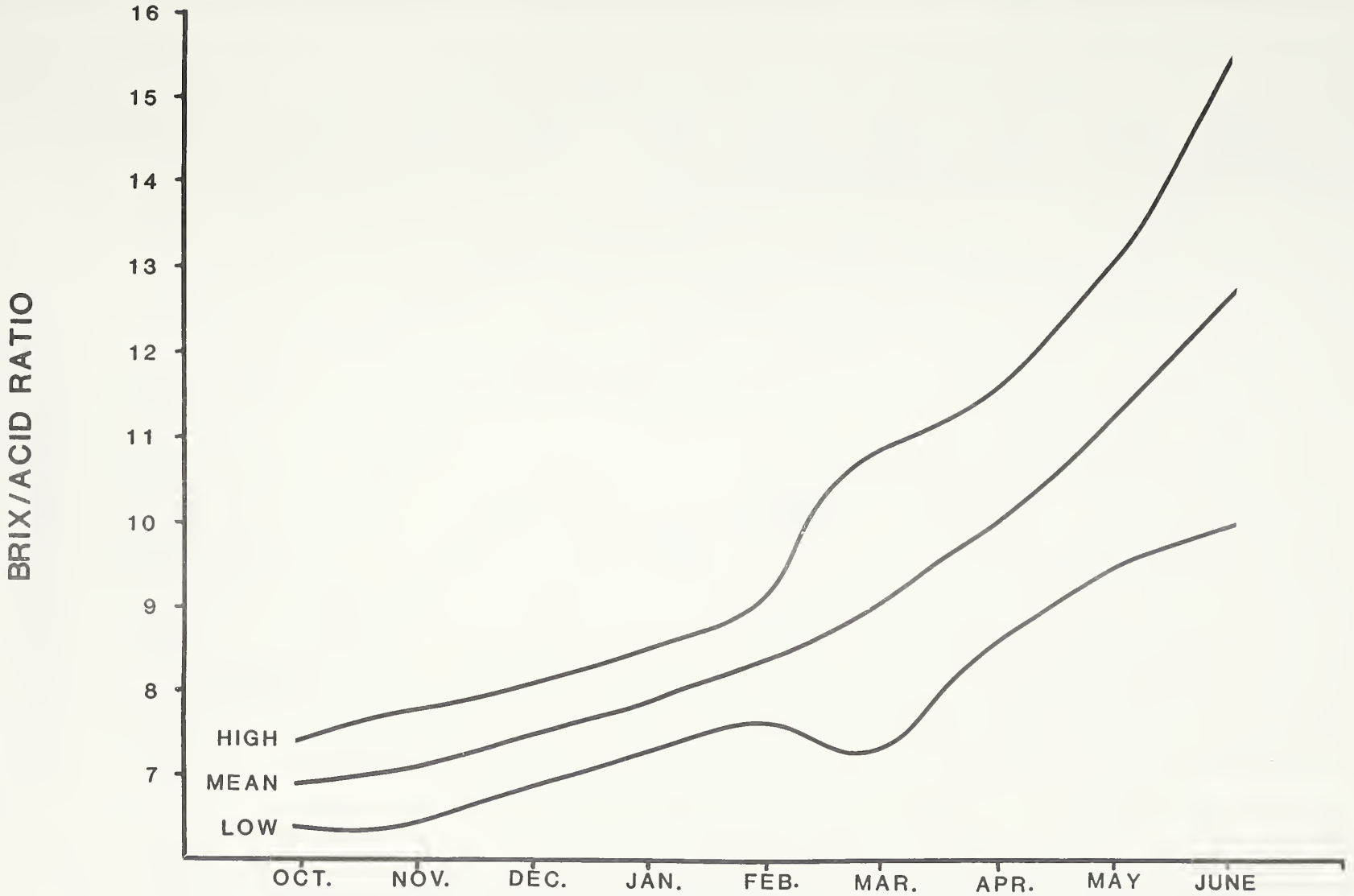

FIGURE 24.—Monthly trends and variations in Brix/acid ratio for 'Ruby Red' grapefruit.

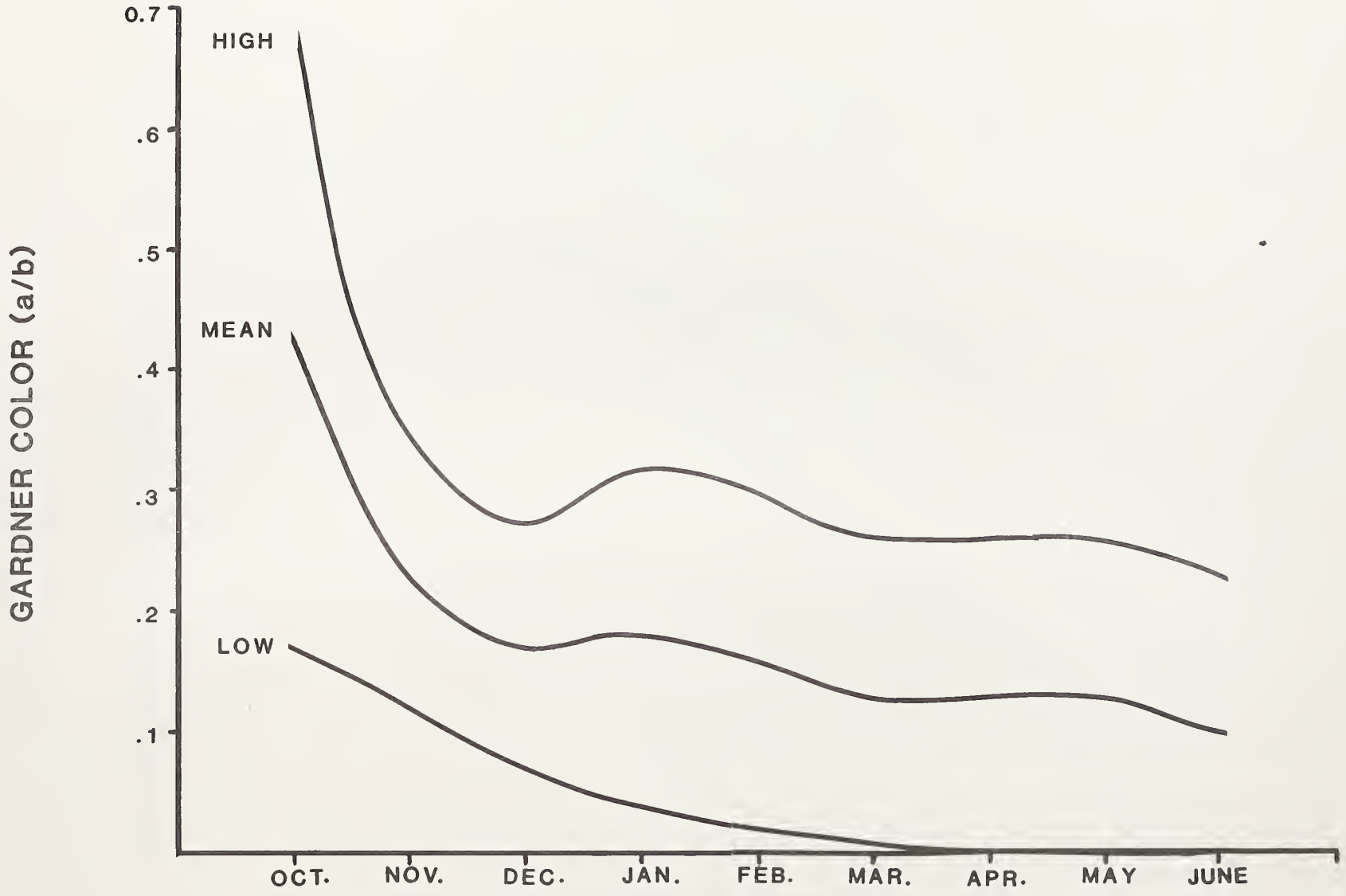

FIGURE 25.—Monthly trends and variations in Gardner color ratio (*a*/*b*) for 'Ruby Red' grapefruit.

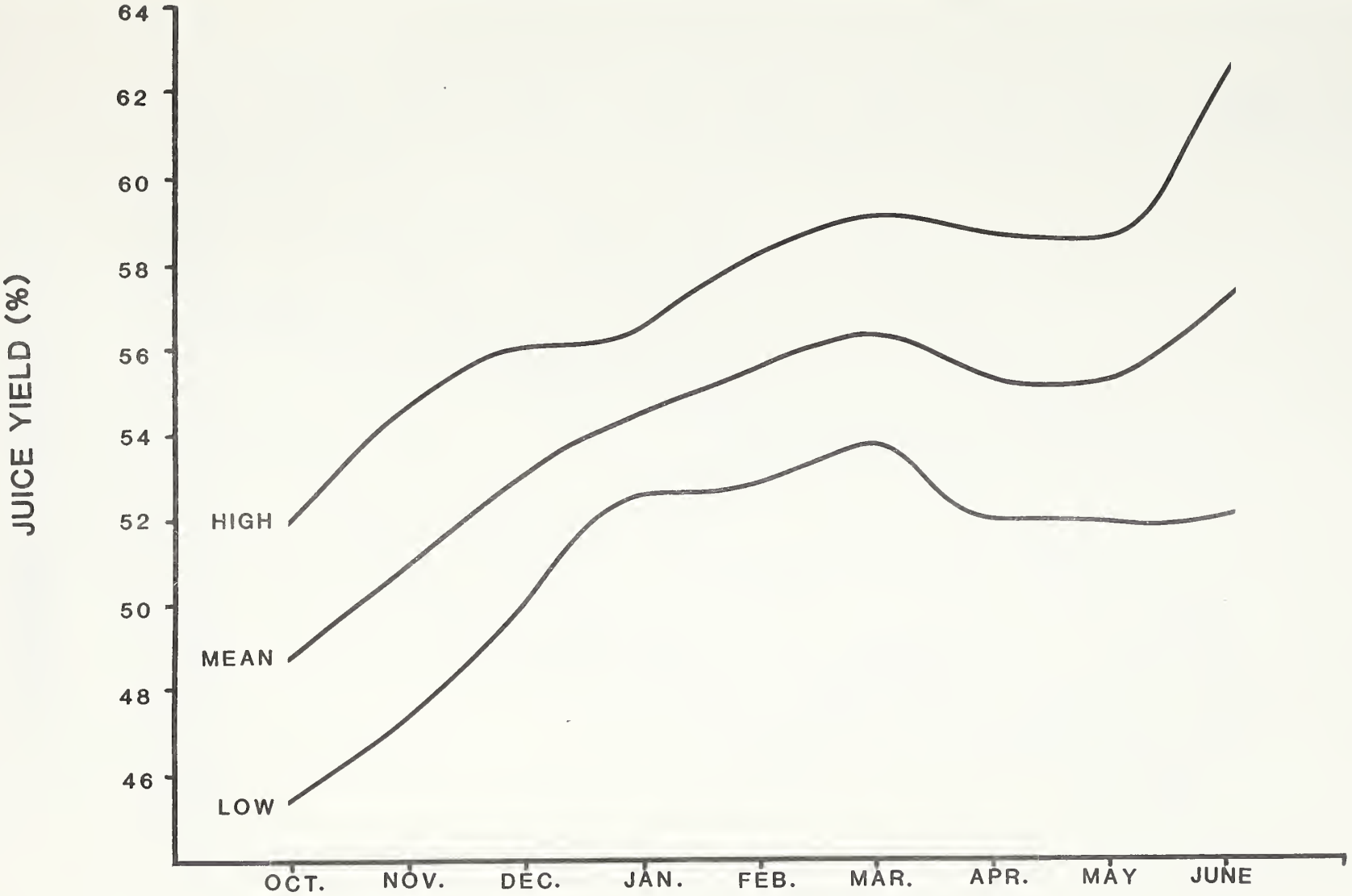

FIGURE 26.—Monthly trends and variations in percentage of juice from 'Ruby Red' grapefruit.

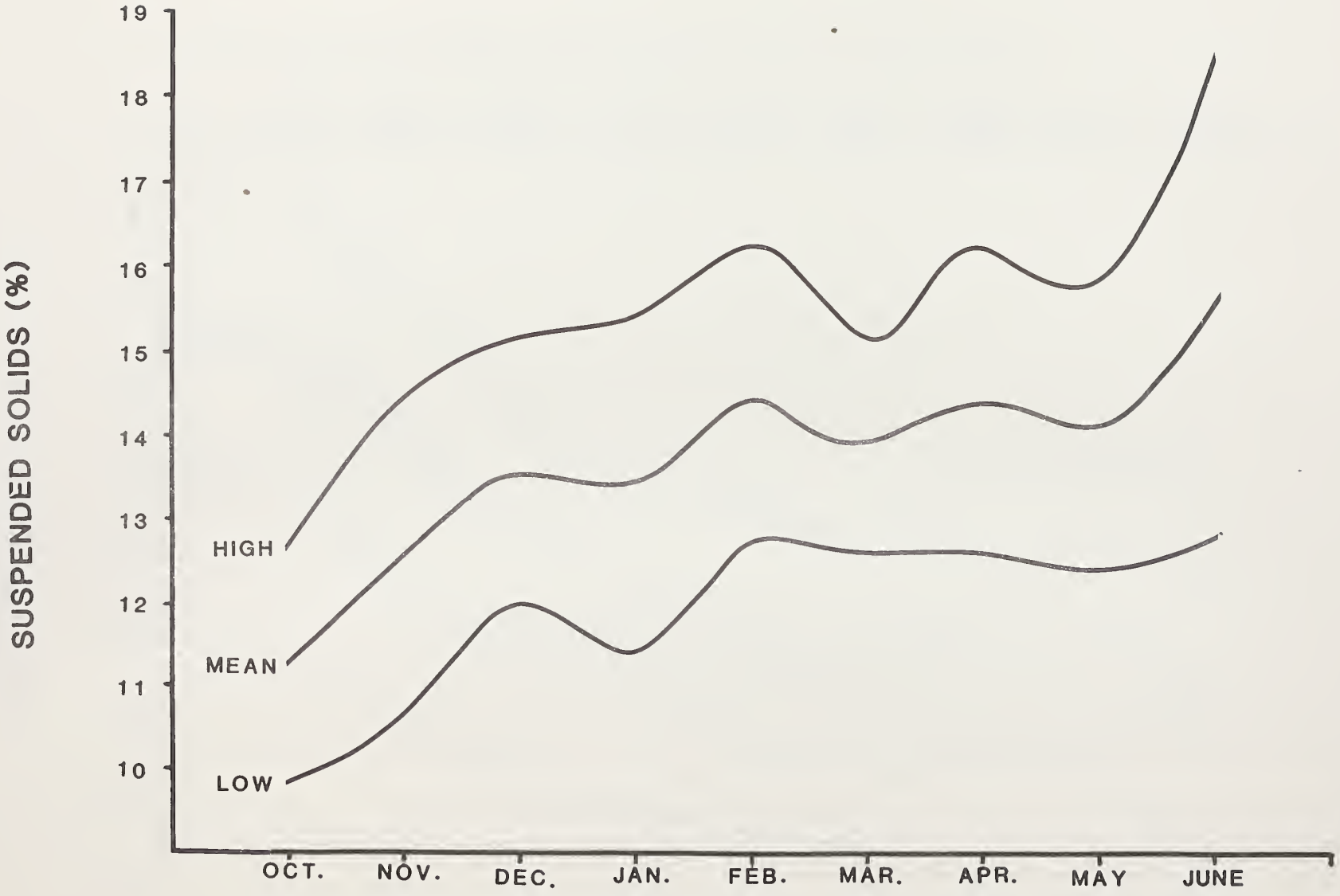

FIGURE 27.—Monthly trends and variations in percentage of suspended solids in 'Ruby Red' grapefruit.

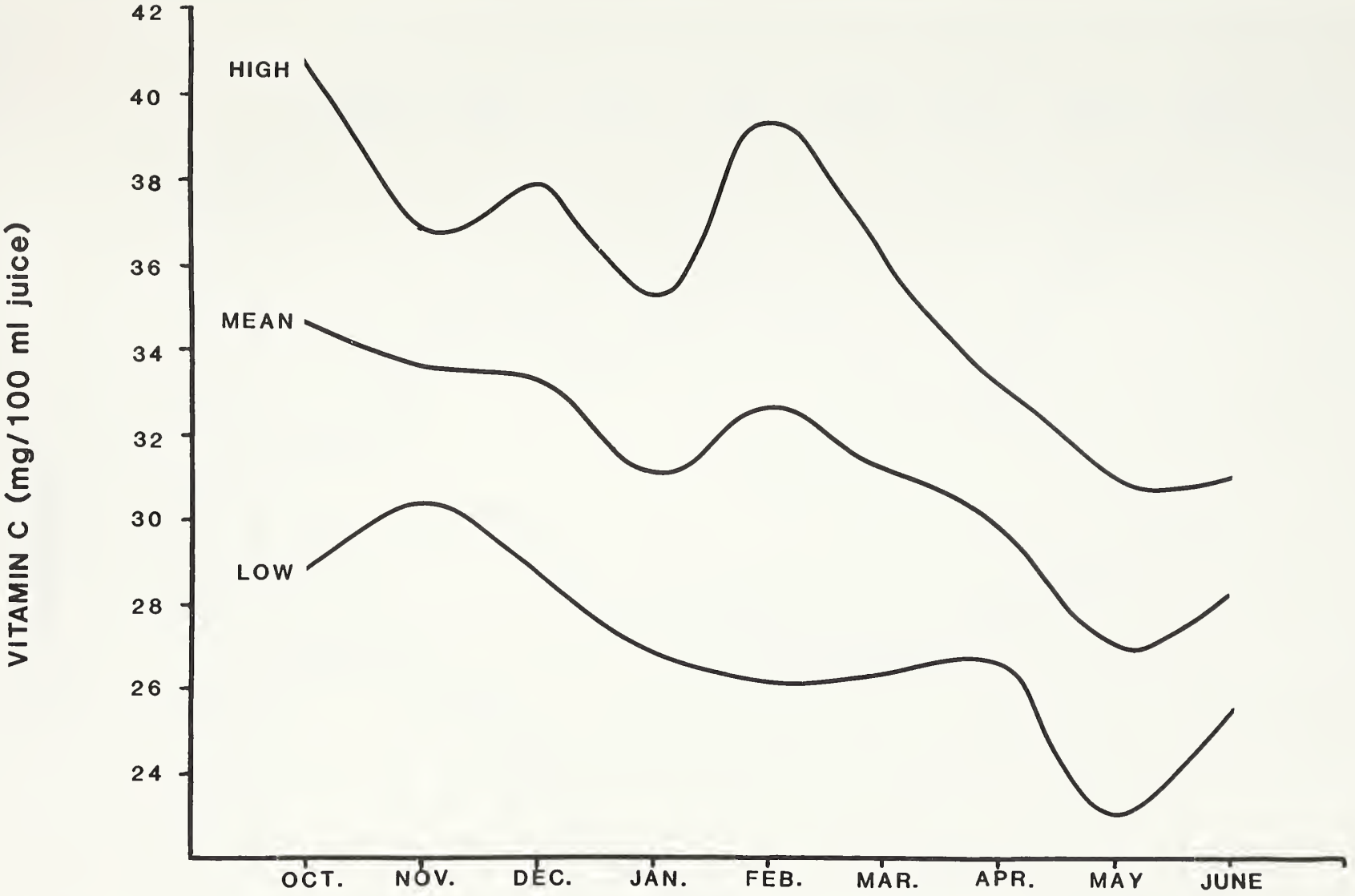

FIGURE 28.—Monthly trends and variations in vitamin C content of 'Ruby Red' grapefruit.

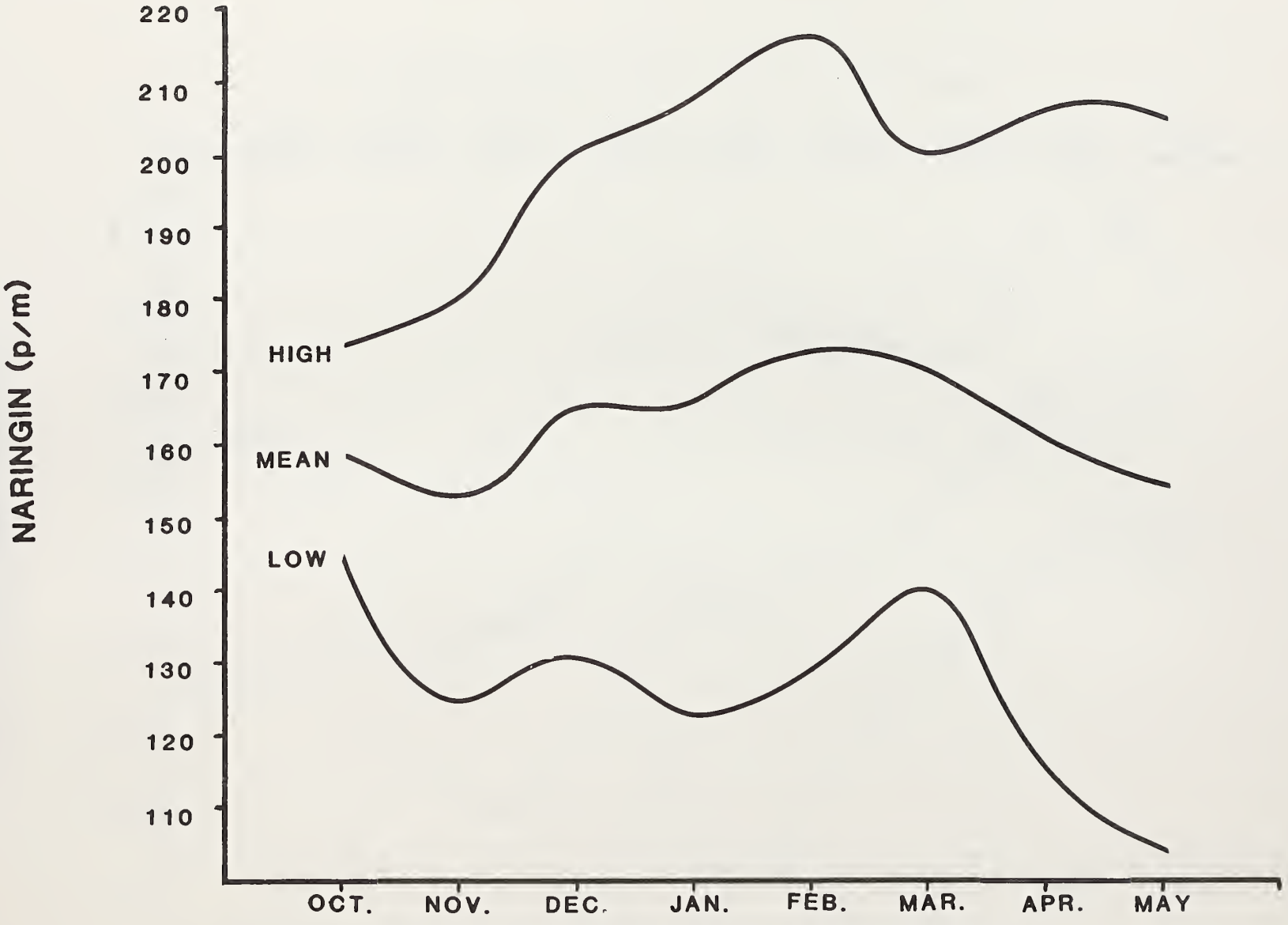

FIGURE 29.—Monthly trends and variations in naringin content of 'Ruby Red' grapefruit.

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